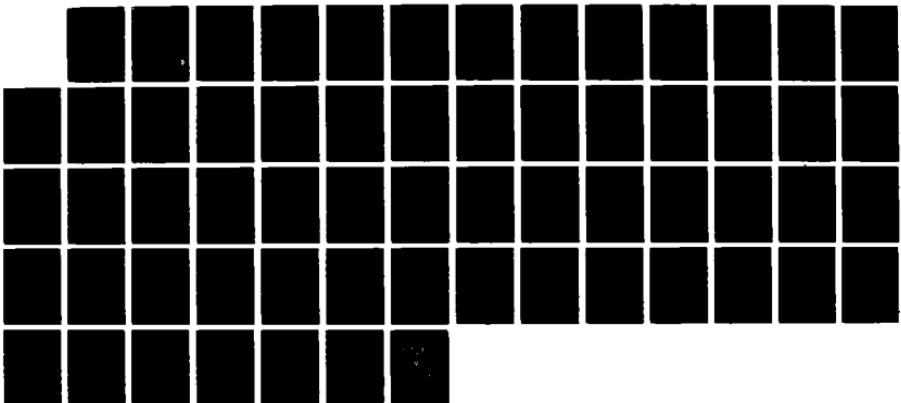
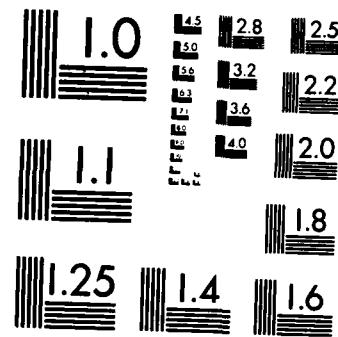


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US Army Corps  
of Engineers  
Construction Engineering  
Research Laboratory

USA-CERL TECHNICAL REPORT P-87/16  
September 1987

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# An Investigation of the Service Writer Methodology in Directorate of Engineering and Housing Vehicle Maintenance Shops

by  
Carla Mond Snyder  
Todd O. Burger

This research was to determine the effects of the Service Writer Methodology on responsiveness and turnaround time in Directorate of Engineering and Housing (DEH) vehicle maintenance shops and to collect data on productive, indirect productive, and nonproductive time to be used in a draft staffing guide currently being developed. The process was investigated at the DEH maintenance activities at Fort Riley, KS and Fort Bragg, NC.

Contractor human factors engineers observed and recorded work activities and collected data on maintenance, labor, and parts costs. An analysis was then made to compare costs of the Service Writer process with those generated following the guidance of The Army Maintenance Management System (TAMMS). Test results show that the Service Writer Methodology reduced labor costs by 13.5 percent and total maintenance costs by 6.4 percent.

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## FOREWORD

This research was performed for the Office of the Chief of Engineers (OCE) under the Operations and Maintenance, Army, Facilities Technology Applications Test Program. The research was directed by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) and conducted by Arthur D. Little, Inc., Cambridge, MA. The Contract Order No. is DACA88-86-D-0015; Registration No. CERL-ES-85-262, #A014: Delivery Order No. 11, "Investigation of the Service Writer Operations in DEH Vehicle Maintenance Shops at Fort Bragg, NC and Fort Riley, KS." USA-CERL's Contract Monitor was Mr. Robert Blackmon. The OCE Technical Monitor was Mr. Walter Seip, DAEN-ZCF-B.

This investigation was performed by Carla Mond Snyder, Todd Burger, Kirk Goodall, Marion Wentworth, and Tom Parrish of Arthur D. Little, Inc. The Technical Editor was Gloria J. Wienke, Information Management Office.

The cooperation of the Directorate of Engineering and Housing (DEH) equipment maintenance personnel at Fort Bragg and Fort Riley is gratefully acknowledged.

COL Norman C. Hintz is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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# **AN INVESTIGATION OF THE SERVICE WRITER METHODOLOGY IN DIRECTORATE OF ENGINEERING AND HOUSING VEHICLE MAINTENANCE SHOPS**

## **1 INTRODUCTION**

### **Background**

Current work processes at maintenance activities involve redundant inspections and lack a central location for receipt and work authorization on a vehicle. Previous investigations of the Director of Engineering and Housing (DEH) equipment maintenance activities on U.S. Army installations indicated opportunities to increase the productivity of operations.<sup>1</sup> One opportunity was to use the Service Writer Methodology. This is a process in which an individual (the Service Writer) is the single initial point of contact between a vehicle operator and the maintenance organization, and a mechanic is responsible for analyzing the problem (inspecting the vehicle) and accomplishing the related work. The mechanic is also responsible for both the workmanship and timely completion of the job.

The Office of the Chief of Engineers (OCE) asked the U.S. Army Construction Engineering Research Laboratory (USA-CERL) to investigate this methodology and compare the results to a model employing The Army Maintenance Management System (TAMMS) as detailed in Department of the Army Pamphlet (DA PAM) 738-750.<sup>2</sup>

The obvious dissimilarities between the DEH equipment maintenance workforce and their troop unit soldier counterparts offers opportunities for increasing productivity of the workforce. The most dramatic difference is in work experience. TAMMS has a tactical orientation and must accommodate a young workforce of soldiers who recently graduated from their first exposure to equipment maintenance. Because journeyman level performance cannot be expected from these soldiers, additional supervision and quality control (inspection) is part of TAMMS. On the other hand, the average DEH mechanic is about 50 years old and has the maintenance expertise associated with years of experience. The Service Writer Methodology provides an opportunity to take full advantage of this expertise by placing more responsibility on the mechanics. Mechanics inspect the incoming vehicles, determine the work to be accomplished, perform the work, and check their work before releasing the vehicles to operators. This assignment of responsibilities eliminates the need for full-time inspectors and a formal inspection procedure, and results in reduced cost and improved turnaround time.

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<sup>1</sup>P. J. Tanner and K. R. Aytogu, *A Model for Analysis of Alternative Performance Structures for Vehicle Maintenance Functions of the U.S. Army Installation Directorates of Engineering and Housing*, Technical Report P-86/07/A169716 (DEH Equipment Maintenance Management, June 1986); P. J. Tanner and K. R. Aytogu, *Vehicle Maintenance Manpower Requirements for U.S. Army Installation Directorates of Engineering and Housing Based on Air Force, Navy, and Army Reserves' Staffing Techniques*, Interim Report P-86/09/A172181 (DEH Equipment Maintenance Management, July 1986).

<sup>2</sup>DA PAM 738-750, *The Army Maintenance Management System (TAMMS)*, Change 8 (Headquarters, Department of the Army [HQDA], 1 December 1983).

During FY86, current Army staffing guides for vehicle maintenance shops were compared with Air Force and Army Reserve staffing guides. During FY87, the investigation was extended to include Navy staffing guides. While some comparisons could be made, the data available from Army maintenance activities was insufficient to complete the comparisons and develop a draft staffing guide for the Army. Detailed field data collected and analyzed in this project will be used to satisfy part of the data required in the draft staffing guide.

### **Objectives**

The objectives of this study were: (1) to determine the effects of the Service Writer process on responsiveness and turnaround time in the DEH vehicle maintenance shops, and (2) to collect data for estimating productive, indirect productive, and nonproductive time of maintenance activities performed by shop mechanics for use in a draft staffing guide currently under development.

### **Approach**

The Service Writer concept was evaluated through a series of four tasks: (1) test planning, (2) development of test parameters, (3) data collection, and (4) data analysis.

The initial approach included collecting and combining performance data from two DEH installations to generate a representative sample of maintenance operations. Human factors engineers were to investigate vehicle maintenance operations at both installations through interviews and observations of actual operations. A copy of all maintenance work orders completed during the past 12 months was to be obtained from both installations. This information was to be analyzed to determine the number of unit and support repair tasks, labor costs, and parts costs.

### **Scope**

This study is an analysis of the effect of the Service Writer concept on the responsiveness and turnaround time of DEH vehicle maintenance shops. It is not an investigation of shop management, repair methods, or the productivity of individual mechanics. This study is applicable to DEH shops performing maintenance with in-house mechanics.

### **Mode of Technology Transfer**

Results of this analysis will be used to determine the appropriateness of the Service Writer concept for all DEH organizations. The results will be transferred through publication of this report and other documents prepared by OCE. Data on productive, indirect productive, and nonproductive time will be used in a draft staffing guide currently being developed.

## 2 METHODS

### General

A realistic evaluation of the Service Writer concept would involve selecting a test installation, reorganizing the vehicle maintenance shop, and analyzing operations after a short period of time. However, such an approach would cause personnel problems and possibly bias the results. While seeking an alternative approach, an investigation of actual field operations identified Fort Bragg, NC and Fort Riley, KS as possible field sites since each activity had independently implemented a version of the Service Writer Methodology.

The TAMMS process for operating a vehicle maintenance shop was investigated with emphasis on identifying all activities, interfaces, decision points, and personnel responsibilities. The TAMMS process is illustrated in Figure A1. A description of the Service Writer concept (Figure A2) was detailed and compared with the TAMMS process to identify the differences.

Responsibilities of the Inspector in TAMMS are divided between the Service Writer and the Mechanics in the Service Writer concept. Army Regulation (AR) 750-1<sup>3</sup> classifies maintenance work as either unit or support level maintenance. Unit level maintenance includes routine services and component replacement which require only small hand tools, no major diagnostic effort, and generally require few man-hours. Intermediate direct support level maintenance includes all nonroutine repairs that often require bench tools, significant diagnostic efforts, and more man-hours. Support level maintenance is often accomplished by another maintenance activity.

### Selection of Test Site

During the test planning activities, vehicle maintenance operations were investigated at Fort Bragg, NC and Fort Riley, KS to determine if data from these installations would meet the the analysis requirements. Both installations were using a variation of the Service Writer concept.

The initial approach included collecting and analyzing data from both installations to reduce the possibility of site bias. However, this approach was not feasible due to the dissimilarities between the two installations. Specifically, the shops do not have a similar layout; the Fort Riley shop is located in a single building requiring minimum walking to reach all functional areas, and the Fort Bragg shop is located in several buildings. The Clerk/Service Writer is located in one building, maintenance is performed in several other buildings, and parts inventory is in yet another building. Because the process at Fort Bragg is longer due to the separation of functions, test results could not be directly compared to other installations. Therefore, Fort Riley was selected as the representative test site.

Operations at both shops were identified through interviews and observations. Flow charts describing the maintenance process at Fort Riley are shown in Figure A3. Allowing for the difference in functions, the processes are very similar.

<sup>3</sup> AR 750-1, Army Materiel Maintenance Concepts and Policies, Change 4 (HQDA, 1 May 1986).

## Test Parameters and Duration

Test parameters were identified based on the requirement to determine:

1. The average total time (in hours) for a mechanic to complete inspection and repair of a unit level maintenance case, and
2. The average total time (in hours) for a mechanic to complete inspection and repair of a support level maintenance case.

The original program plan required 3 days of data collection in each shop for a combined test sample of 6 days. Because data from Fort Bragg would not be representative of most maintenance shops, the plan was changed to 6 days of data collection at Fort Riley.

## Data Collection

Human factors engineers prepared the data collection plan for the study (Appendix B). The plan specified that two test engineers would observe and collect data for 6 work days. Six heavy mobile equipment repairers would be the test subjects. The plan also specified the data collection forms. The mechanic's activities were recorded as directly productive, indirectly productive, and nonproductive.\* As additional activities were observed, they were added to the forms by the test engineers. The senior human factors engineer classified the additional tasks.

The field study was conducted during the week of 17 November 1986. Tables C1 and C2 present examples of the raw data collected during the field study. The following information was recorded at the top of each report:

Test Engineer's Name  
Mechanic's Name  
Date of Observation  
Vehicle Being Maintained  
Vehicle Type (Heavy Equipment, Automotive Equipment,  
Seasonal Equipment, Generators)  
Start Time  
End Time  
Maintenance Type (Unit or Support)

The operational data were collected by each observer monitoring the activities of one mechanic during an 8-hr working period. Activities were described by sequence number, time required to complete, productivity category, and a description of the activity. Additional space for comments was provided.

---

\*Directly productive labor applies directly to the workload; i.e., the repair task. Indirectly productive labor, because it is incurred for common or joint objectives, is not readily subject to treatment as productive labor. Nonproductive is the time not expended on the workload (i.e., eating lunch and cleaning the work area or hands).

## 1986 Data Base

The Fort Riley DEH provided a data base containing the maintenance work orders completed in the shop over a 12-month period. The material contained 34 individual files formatted for FRAMEWORK, a PC-based spread sheet program. These files were translated into Lotus "WR1" Symphony format for the analysis. The steps involved in this process are depicted in Figure A4. Editing was limited to format changes needed to improve the consistency between files. The files reported approximately 16,000 repair tasks. The data is summarized in Appendix D.

Each task was coded as unit or support level maintenance using the criteria provided in AR 750-1. The coding was done at the repair task level. Service visits generally included more than one task and could require both unit and support level tasks. The data were then analyzed to determine the number of service visits for unit repair tasks only, for support repair tasks only, and for a combination of unit and support repair tasks. Results of this analysis are summarized in Table E1.

A total of 15,609 repair tasks were completed during 3,940 service visits (an average of 4 per visit). Of the 3,940 visits, 2,862 consisted only of unit repairs, 165 consisted only of support repairs, and 913 consisted of both unit and support repair tasks; hence, 1,078 visits had a support level component.

The data were analyzed to determine the effects of the Service Writer process on productivity in terms of:

1. The total annual cost of the mechanic's repair and inspection time for unit level cases
2. The total annual cost of the mechanic's repair and inspection time for support level case
3. The total annual cost of repair and inspection for the Service Writer process (sum of 1 and 2 above)
4. The total annual cost of the inspector's time for unit level cases if TAMMS was followed
5. The total annual cost of the mechanic's time for unit level cases if TAMMS was followed
6. The total annual cost associated with the inspector's time and mechanic's time for unit level cases if TAMMS was followed (sum of 4 and 5 above)
7. The total annual cost of inspector's time for support level cases if TAMMS was followed
8. The total annual cost of mechanic's time for support level cases if TAMMS was followed
9. The total annual cost associated with the inspector's and mechanic's time for support level cases if TAMMS was followed (sum of 7 and 8 above)
10. The total annual cost of inspection and repair if TAMMS was followed (sum of 6 and 9 above)

11. The cost savings resulting from the Service Writer process (difference between 10 and 3 above)
12. The percentage of annual savings resulting from the Service Writer process
13. The average percentage of indirectly productive time for a mechanic in an 8-hr working period
14. The average percentage of directly productive time for a mechanic in an 8-hr working period
15. The average percentage of nonproductive time for a mechanic in an 8-hr working period.

### 3 RESULTS AND ANALYSIS

#### Labor Costs

Frequently, the labor cost was not reported for a repair task, even though the task indicated that some labor had been expended. As a result, the reported labor cost, referred to in Table E2 as the "unadjusted labor dollars" does not reflect the total labor cost. Missing data were calculated by multiplying the relevant labor hours by the standard average labor rate of \$16.76. Table E3 summarizes total parts, labor hours, and adjusted labor dollars. Table E4 combines parts and adjusted labor dollars under unit and support maintenance categories.

#### Reconstruction of TAMMS Costs

Since actual field data was not available, the costs of the TAMMS process were reconstructed. The reconstruction process is outlined in Table E5. Beginning with current Service Writer data, costs related to inspection activities were deleted and estimates of inspections costs under TAMMS were incorporated. The following two approaches for identifying and estimating inspection costs from the Service Writer process costs were considered:

1. Assume the task descriptions of "inspection" and "diagnosis" in the 1986 records were accurate and included all inspection costs. Summarize the cost for these items and subtract it from the total cost of the Fort Riley operations
2. Determine the percentage of total costs pertaining to the inspection/diagnosis labor costs identified in the time-and-motion study and reduce the total annual cost accordingly.

The second approach was used in the analysis. Estimates of TAMMS repair costs were developed based on Service Writer costs less inspection costs, using the following criteria from Tanner and Aytogu, June 1986 and July 1986:

- When a service visit entailed only unit repair tasks, 1.5 hr were added to the labor effort for inspection
- When a service visit entailed only support repair tasks, 2 hr were added to the labor effort for inspection
- When a service visit entailed both unit and support repair tasks, 2 hr were added to the labor effort for inspection (not 3.5 hr)
- One "service visit" as reported on a completed work document was assumed to be equivalent to a "case" referred to in the "Vehicle Maintenance Manpower" report" that provided the inspection time estimates on a per-case basis
- The standard average mechanic labor rate of \$16.76 was applied to the total inspection hours and the results were used to adjust the annual cost estimate.

---

<sup>a</sup>P. S. Tanner and K. R. Aytogu (July 1986).

The data were tested for a possible relationship between reduced inspection time and the quality of repair work performed. If, as a result of lowered inspection levels, vehicles required repeat repairs of the same subsystem due to poor workmanship, repair costs might actually increase using the Service Writer process. The 1986 data was reviewed to determine if any of the vehicles had an excessive number of service visits (Appendix F). On the average, four repair tasks were accomplished each visit. During the year, some vehicles had as few as 2 repair tasks while others had over 100 repair tasks performed. The repair records for the 10 vehicles with the highest number of repair tasks were reviewed. An effort was made to identify multiple repairs for the same problem over a period of a year. While the effort was hampered by inconsistent repair descriptions, there was no clear pattern to indicate a quality control problem. Based on these data, there is no evidence that the reduced inspection efforts inherent in the Service Writer process have led to increased failure rates or deterioration in the quality of service performed.

#### **Comparison of Service Writer and TAMMS Costs**

Based on the data gathered, total unit and support maintenance costs were compared (Table E6). The Service Writer Methodology reduced the total maintenance cost by 6.4 percent and labor cost by 13.5 percent at Fort Riley.

#### **A Sensitivity Analysis**

A sensitivity analysis was done on the estimated cost reductions. These numbers would not change significantly even if the estimate of current inspection effort were off by a large margin. For example, if Service Writer unit and support inspection costs were understated by 20 percent, the labor cost savings would fall from 13.5 to 12.8 percent. Similarly, the cost savings is relatively insensitive to the breakdown between support level and unit level repairs. If the fraction of support level repairs were underestimated by 20 percent, the labor cost savings would rise from 13.5 to 13.9 percent.

#### **Time-and-Motion Observation Results**

Time-and-motion observations from the Fort Riley vehicle maintenance shop are summarized in Table E7. Sixty seven percent of the mechanic's time was spent on unit repair tasks and nearly 5 percent of unit repair time was for inspection and diagnosis. Inspection and diagnosis time were approximately 1 percent of support repair time, reflecting both the higher labor content of support repair tasks and the greater ease of diagnosing major vehicle subsystem failures. Table E8 summarizes key findings; it is a simplified version of Table E7.

It should be noted that this data overstates the productivity of the mechanics due to the Hawthorne Effect and may require adjustment before being used in the draft staffing guide. (The Hawthorne Effect is the increased productivity observed in workers when they know they are being studied.)

## **4 CONCLUSIONS AND RECOMMENDATION**

### **Conclusions**

The Service Writer Methodology is viable and has reduced labor costs by 13.5 percent and total maintenance costs by 6.4 percent at Fort Riley, KS. The methodology decreases turnaround time and improves the responsiveness of the DEH shops to mission requirements.

The use of a Service Writer and increasing the responsibilities of the mechanics does not result in increased failure rates.

The process provides an opportunity for a better interface between the DEH and its customers through the Service Writer.

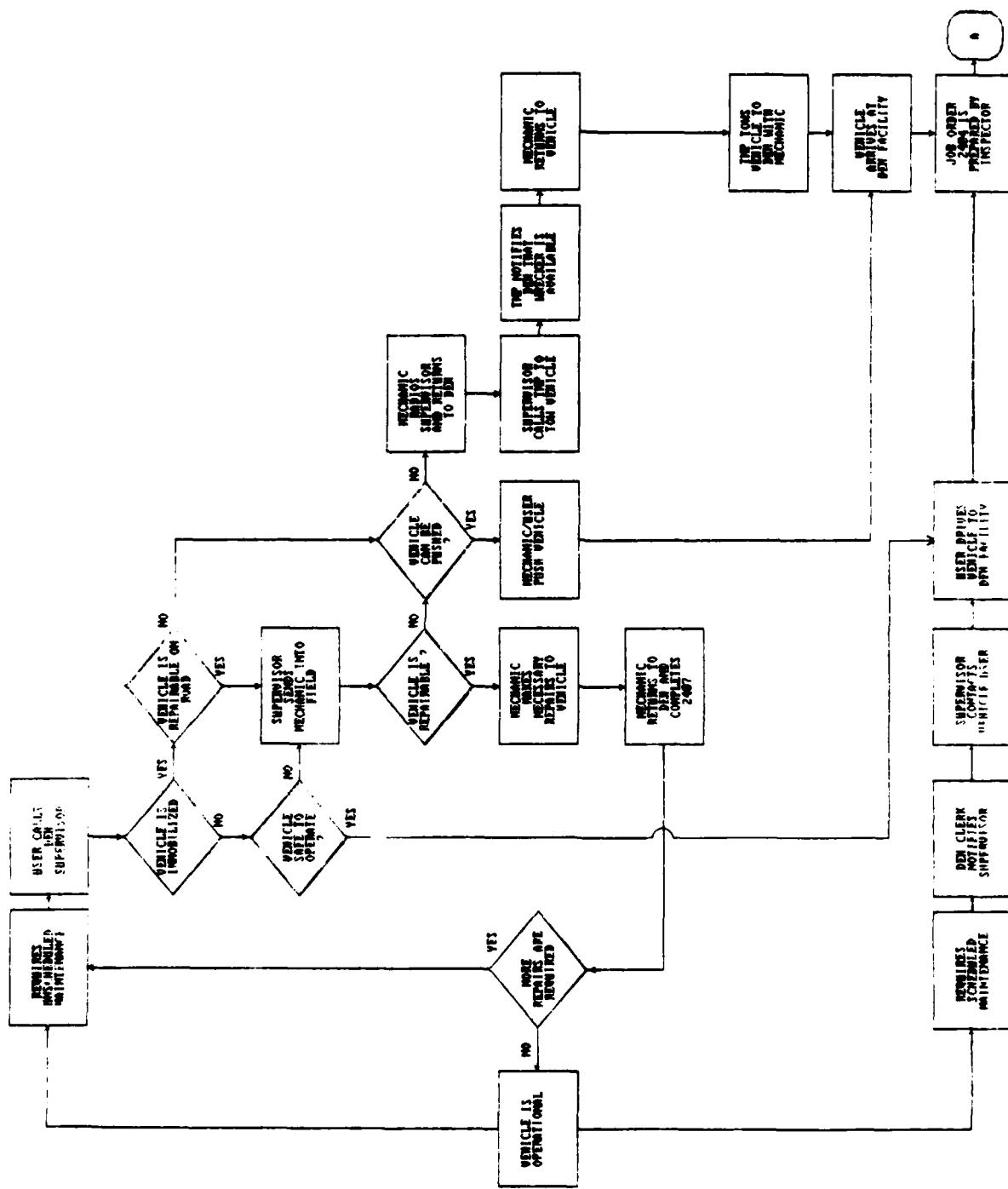
The study provided data on the distribution of the mechanic's time for use in the draft staffing guide. This data overstates the productivity of the mechanics and may require adjustment before further use.

Based on the observed conditions of data, a system should be developed and implemented for systematically collecting vehicle maintenance and failure data. This system should simplify the collection of maintenance management data, including the possible use of codes for repair tasks. Tracking the use of repair parts should also be included in the system.

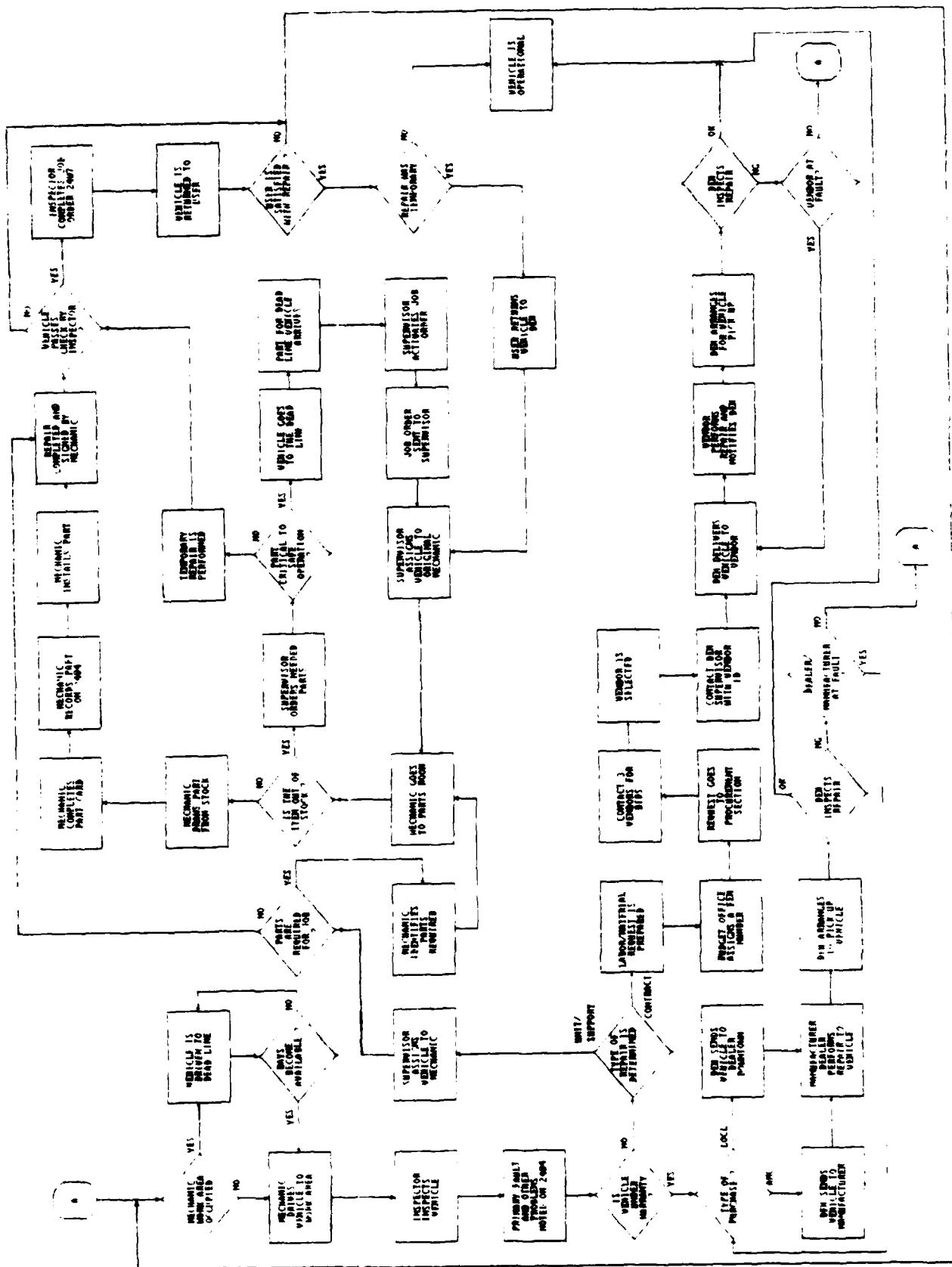
### **Recommendation**

The Service Writer process should be considered for incorporation into all DEH vehicle maintenance shop operations to reduce maintenance cost and turnaround time.

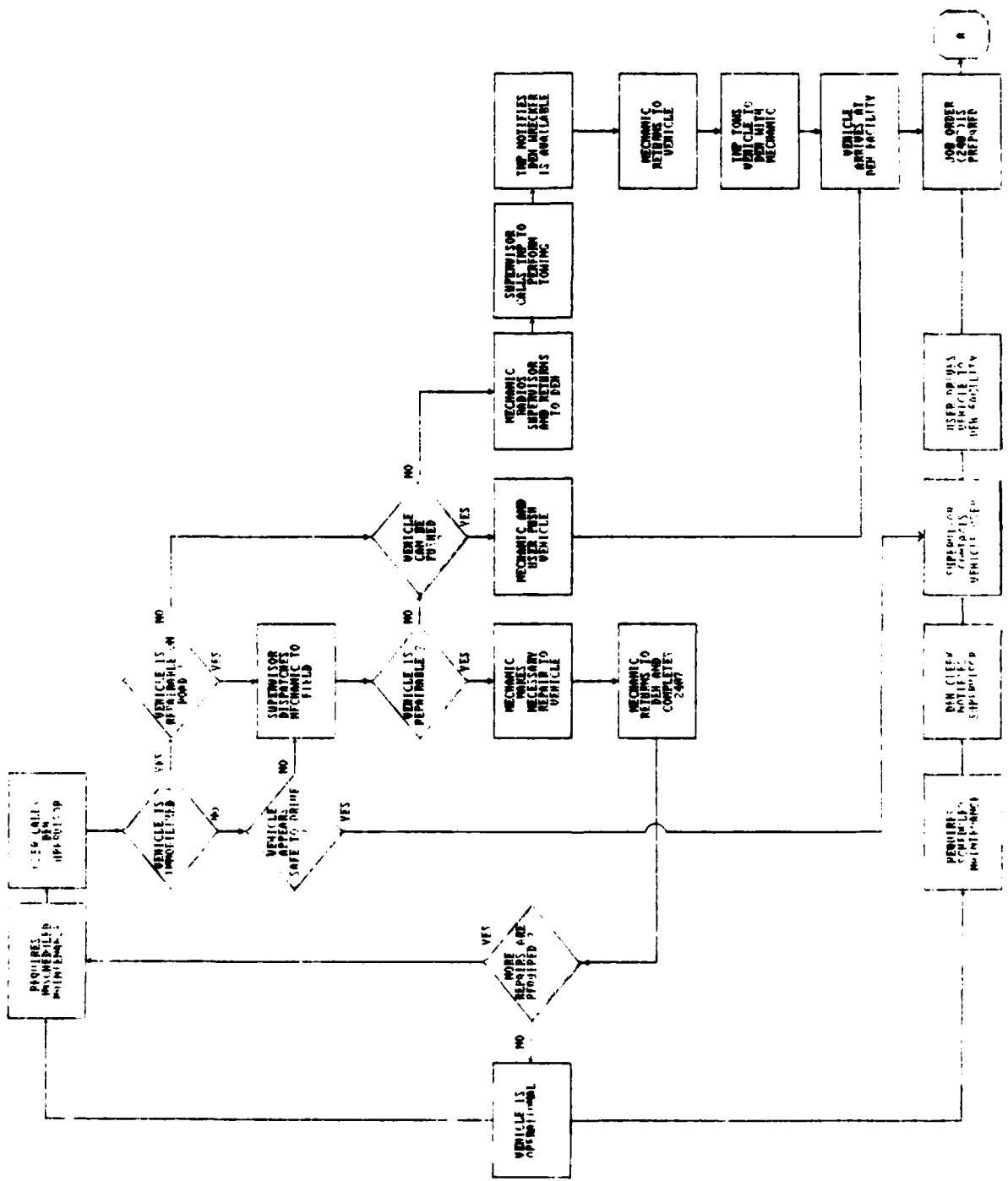
## **APPENDIX A: FLOW CHARTS**



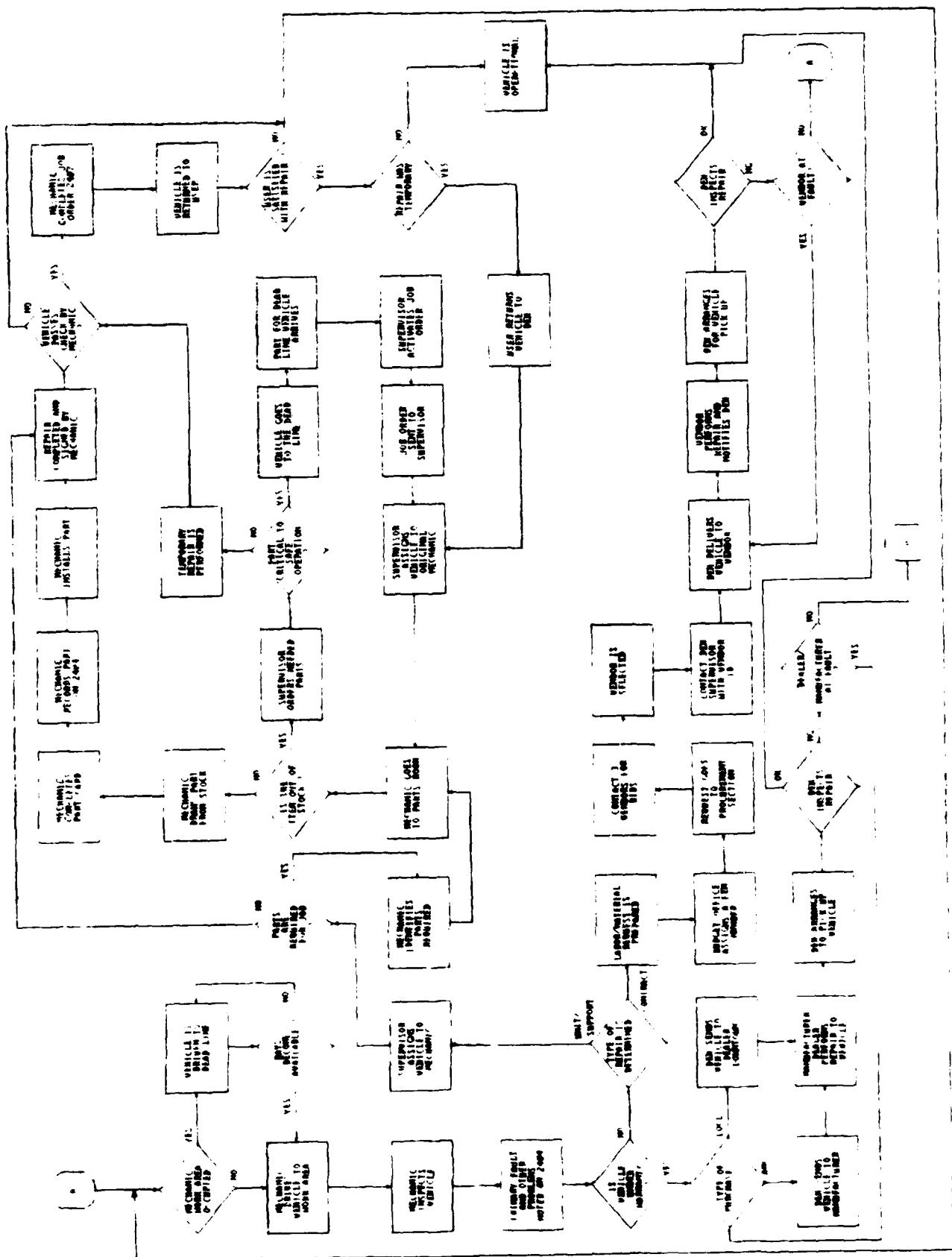
**Figure A1.** The Army Maintenance Management System (AMMS) approach.



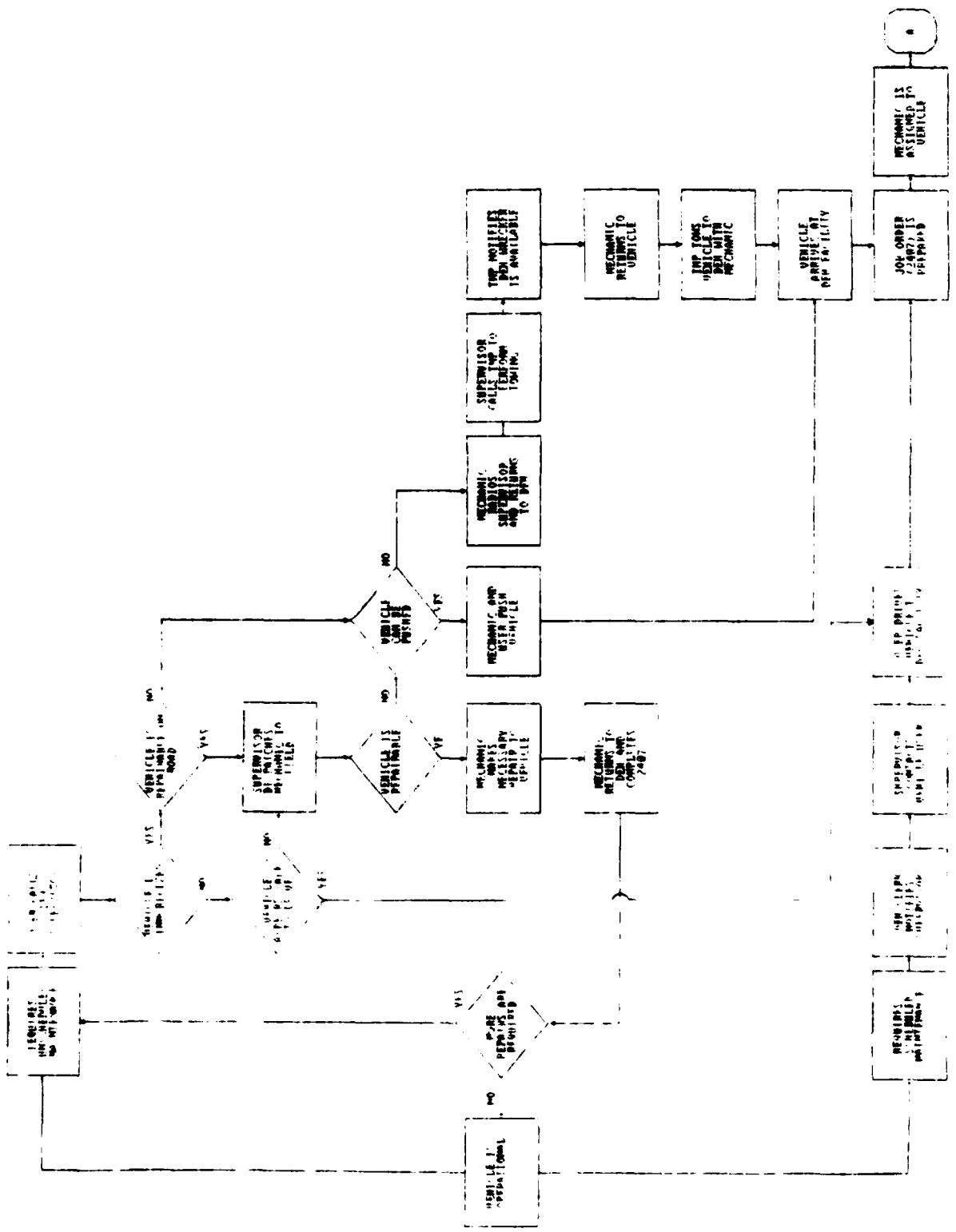
**Figure A1** (Cont'd).



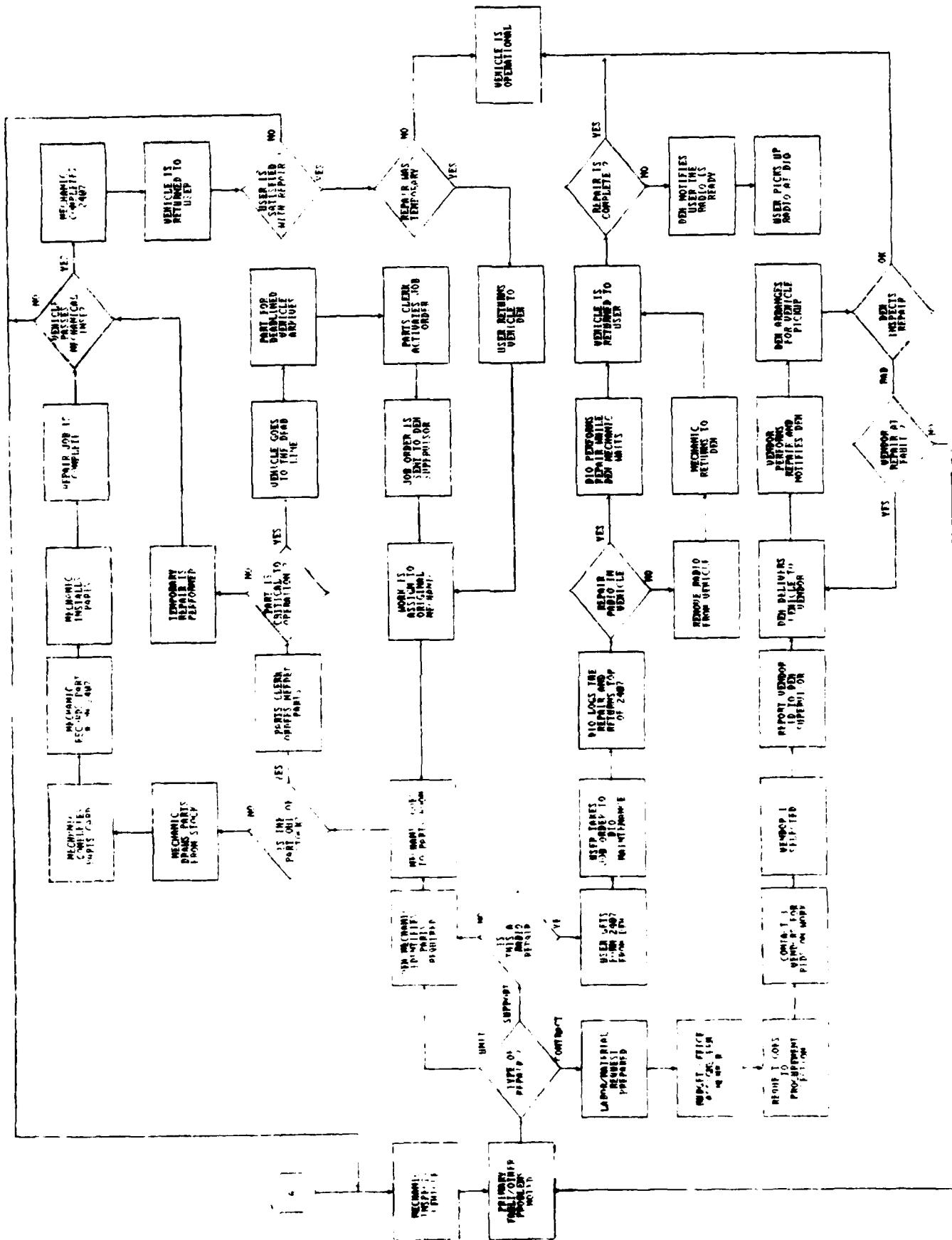
**Figure A2.** Service Writer concept.



**Figure A2 (Cont'd).**



**Figure A3.** Flow chart of maintenance operations at Fort Riley, KS.



**Figure A3 (Cont'd).**

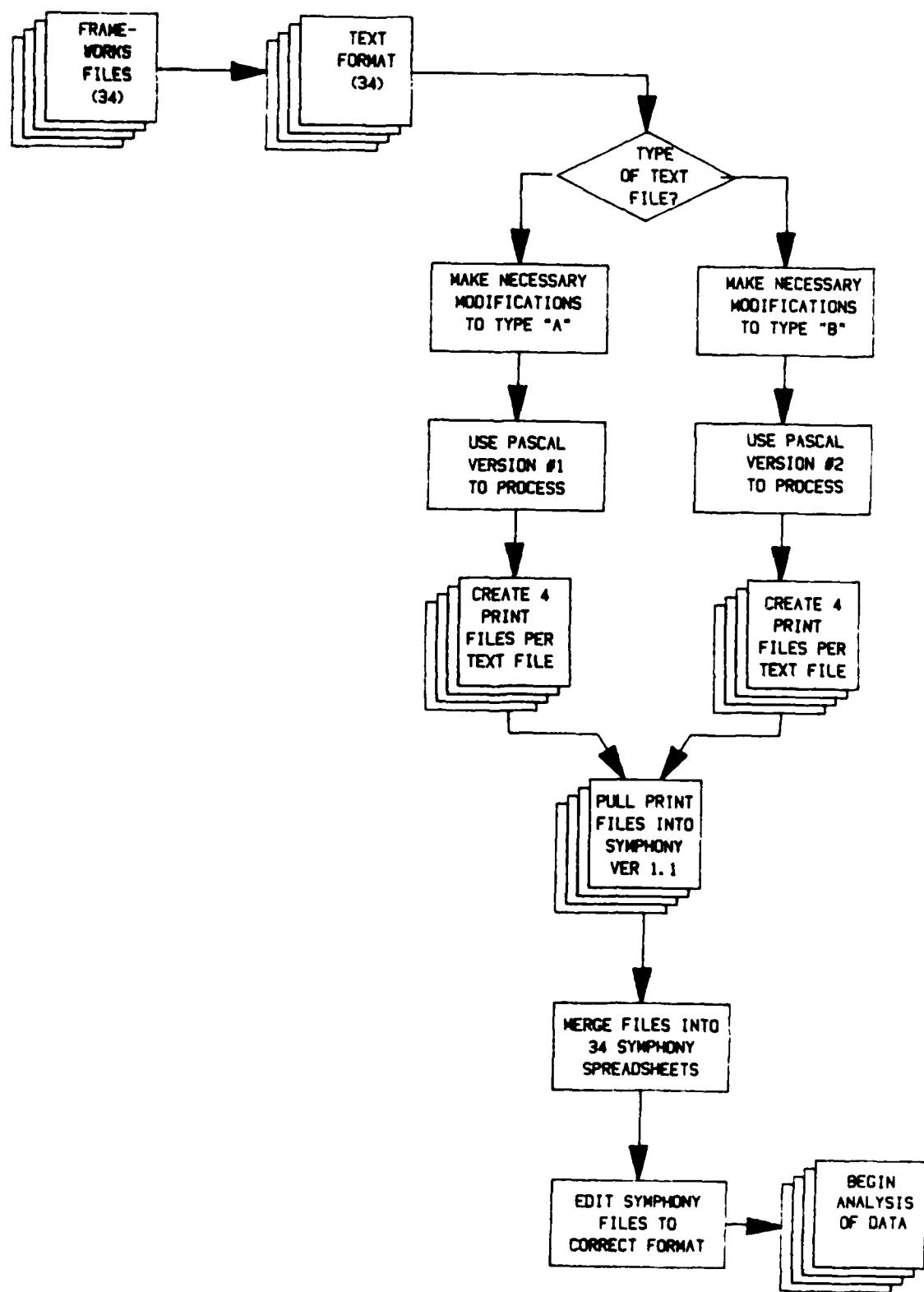


Figure A4. File processing flow for repair task data.

## **APPENDIX B: DATA COLLECTION PLAN**

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Delivery Order No. **0011**

**INVESTIGATION OF THE SERVICE WRITER OPERATIONS IN  
DEH VEHICLE MAINTENANCE SHOPS AT FORT RILEY, KS**

**Task 2, Data Collection Plan**

**Prepared for**

**US ARMY CONSTRUCTION ENGINEERING RESEARCH LAB  
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**Prepared by**

**ARTHUR D. LITTLE, INC.  
CAMBRIDGE, MA 02150**

**ADL Reference: 55119-19**

**November 1986**

## INVESTIGATION OF SERVICE WRITER METHODOLOGY

### DATA COLLECTION PLAN

#### 1. INTRODUCTION

Investigations of the DEH equipment maintenance process at U.S. Army installations by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) indicated opportunities to increase the productivity of the operations. Current work processes involve redundant inspections without a central location for receipt and work authorization on a vehicle. The Service Writer Methodology is a process by which an individual (the service writer) acts as the single initial point of contact between a vehicle operator and a maintenance organization. USA-CERL was tasked to investigate this methodology by studying the operations at Fort Bragg, NC and Fort Riley, KS. Based on the results of the initial field visits to these sites, it was decided that only Fort Riley would be included in this program.

#### 2. PURPOSE

The purpose of this protocol is to define the data collection plan for developing estimates of productive, indirect productive and non-productive time for maintenance personnel.

#### 3. OBJECTIVE

The objective of the field test is to provide data with which to develop estimates of staff time utilization for maintenance personnel as input to a staffing guide.

#### 4. SCOPE

Fort Riley, KS will be the only test site for this activity. Data will be collected over a six day period by two test engineers from Arthur D. Little, Inc., Cambridge. The six heavy mobile equipment repairers (WG-5803-10) will be used as test subjects.

Productive, indirect productive, and non-productive time estimates will be obtained twice (see Table 1) for each of the maintenance personnel according to the data collection forms shown in Section 10 - Data Collection Forms. Depending on the work load conditions at Fort Riley during the week of testing, an effort will be made to obtain total time (in hours) for each of these mechanics to complete inspection and repair of both a unit and support level maintenance case.

#### 5. TEST SCHEDULE

The test program is scheduled to begin on Monday, November 17, 1986 and proceed through Saturday, November 22, 1986. Monday through Friday testing will begin at 7:30 AM and conclude at 4:00 PM, whereas, on Saturday testing will proceed between 6:00 AM and 2:30 PM, to be consistent with the work shifts at Fort Riley. Table 1 depicts the idealized data collection schedule.

Again, it is noted that the ability to obtain data for both a unit and support level maintenance case for each mechanic is dependent on the nature of the work loading at Fort Riley during the week of November 17, 1986.

#### 6. CERTIFICATION AND TEST RECORDS

At the conclusion of each day's testing, the data collection forms will be dated and initialed by the senior test engineer. Additional comments or observations on the testing will also be recorded, dated, and signed by the senior test engineer. Any photographs taken will also serve as test records. These records will be maintained by Arthur D. Little, Inc. for future reference and inspection by USA-CERL personnel.

TABLE 1  
MAINTENANCE LEVEL CASE MIX

<u>Day</u>	<u>Mechanic</u>	<u>Test Engineer</u>	<u>Maintenance Level Case</u>
Nov. 17	1	1	50% Unit; 50% Support
Nov. 17	2	2	" Unit " "
Nov. 18	3	1	" Unit " "
Nov. 18	4	2	" Unit " "
Nov. 19	5	1	" Unit " "
Nov. 19	6	2	" Unit " "
Nov. 20	1	1	" Support " "
Nov. 20	2	2	" Support " "
Nov. 21	3	1	" Support " "
Nov. 21	4	2	" Support " "
Nov. 22	5	1	" Support " "
Nov. 22	6	2	" Support " "

7. TEST CONDITIONS

Since testing will be done at the Fort Riley, KS vehicle maintenance facility, the test conditions will be standard ambient. Mid-day temperature readings will be obtained for each day of testing.

8. EQUIPMENT REQUIRED

Camera

2 Stop watches

Tape Measure

Data Collection Plan

9. PROTOCOL

As illustrated in Table 1, each test engineer will be assigned to a different mechanic each day of testing. Only the six heavy equipment repairers (WG-5803-10) will be used in this test program. The goal will be to obtain data, as per the forms described in Section 10, for both a unit and support level maintenance case for each mechanic. Achievement of this goal is strongly dependent on the work orders at Fort Riley during the week of November 17, 1986.

10. DATA COLLECTIONS FORMS

The forms that follow will be completed by the Arthur D. Little, Inc., test engineers during the course of the field test.

PROFILE OF MECHANICS

<u>Name</u>	<u>ID No.</u>	<u>Age</u>	<u>Years of Experience</u>	<u>Years at Ft. Riley</u>

Test Engineer: \_\_\_\_\_

Date \_\_\_\_\_

Mechanic: \_\_\_\_\_

Vehicle: \_\_\_\_\_

HE SE AE G

Start Time: \_\_\_\_\_

End Time: \_\_\_\_\_

<u>Task/Activity</u>	<u>Activity Order</u>	<u>Classification (P, IP, NP)</u>	<u>Time Elapsed</u>
Obtain work order		IP	
Talk to vehicle operator		IP	
Move vehicles		IP	
Obtain bay		IP	
Walk to tools		NP	
Select tools		IP	
Diagnose problem		P	
Prepare work order		IP	
Modify work order		IP	
Walk to parts inventory		NP	
Obtain parts		P	
Complete parts inventory forms		NP	

## DATA COLLECTION FORM (Continued)

<u>Task/Activity</u>	<u>Activity Order</u>	<u>Classification (P, 1P, NP)</u>	<u>Time Elapsed</u>
Wait for tools		NP	
Position vehicle for access		P	
Position self with respect to vehicle		P	
Repair		P	
Request/Wait for assistance		NP	
Prepare vehicle for temporary storage		NP	
Inspect vehicle		IP	
Complete work order		IP	
Return work order to process control clerk		IP	
Replace tools		NP	
Clean work area		IP	
Store replaced parts		NP	
Repair/oil tools		IP	
Clean hands		NP	
Coffee Break		NP	
Lunch Break		NP	

## APPENDIX C: SAMPLE DATA COLLECTION FORMS

Table C1

### Raw Data Collected: Vehicle 1

**Carla** (Test Engineer's Name)  
**George** (Mechanics Name)  
**11/20/86** (Date of Observation)  
**Fire Truck** (Vehicle Being Maintained)  
**HE** (Vehicle Type: Heavy Equip, Automotive Equip,  
 Seasonal Equip, Generators)  
  
**Start/7:37** (Start Time)  
**End/10:54** (End Time)  
**L-Maintenance/Unit Level** (Maintenance Type: Unit or Support)  
**Vehicle was started 11/19/86**

Sequence No.	Time	Category*	Description	Comments
1	1.60	NP	give assistance	
2	3.45	NP	go to/from welding shop	
3	1.80	NP	go to/from welding shop	
4	0.40	NP	talk to supervisor	
5	2.10	NP	give assistance	
6	1.75	IP	select tools	
7	4.00	P	repair	
8	1.90	NP	turn on outlet	
9	14.90	P	repair	
10	0.30	NP	walk to/from tools	
11	0.35	NP	replace tools	
12	0.40	NP	give assistance	
13	0.25	NP	walk to/ from tools	
14	0.40	P	repair	
15	0.40	NP	walk to/from tools	
16	0.60	NP	walk to/from tools	
17	0.65	P	repair	
18	0.20	NP	walk to/from tools	
19	0.20	NP	walk to/from tools	
20	5.70	P	repair	supervisor inspected unit/water pump
21	0.35	NP	walk to parts inventory	
22	2.30	P	obtain parts	
23	0.60	NP	walk from parts inventory	
24	0.45	NP	move tool box	
25	0.20	IP	select tools	
26	68.00	P	repair	replace belt to water pump

\*P = Productive.

NP = Nonproductive.

IP = Indirect productive.

Table C1 (Cont'd)

Sequence No.	Time	Category*	Description	Comments
27	0.69	NP	clean hands	
28	17.00	NP	coffee break	
29	1.35	P	repair	
30	1.35	NP	give assistance	
31	0.30	NP	walk to parts inventory	
32	4.00	NP	complete parts inventory forms	
33	0.90	NP	walk from parts inventory	included talking to vehicle operator changed tasks/battery
34	6.00	P	repair	
35	2.50	IP	talk to vehicle operator	
36	1.00	IP	talk to welder	
37	1.50	IP	select tools	talked to someone about tool box/welding tools
38	2.90	P	repair	
39	2.90	IP	clean work area	
40	3.10	IP	inspect vehicle	
41	2.00	IP	prepare work order	
42	0.55	NP	give assistance	
43	4.60	P	repair	
44	1.25	IP	move vehicles	
45	2.00	P	repair	
46	6.80	IP	road test	have to let vehicle warm up
47	2.00	NP	walk to /from tools	
48	3.10	NP	locate lost tool	
49	1.00	NP	replace tool	
50	2.80	IP	complete work order	at office
51	0.10	IP	return work order to process control clerk	
52	0.60	NP	walk to parts inventory	
53	6.60	NP	order parts	
54	0.60	NP	walk from parts inventory	

END OF VEHICLE FOR NOW

\*P = Productive.

NP = Nonproductive.

IP = Indirect productive.

**Table C2****Raw Data Collected: Vehicle 2**

**Carla** (Test Engineer's Name)  
**George** (Mechanics Name)  
**11/20/86** (Date of Observation)  
**Fire Truck** (Vehicle Being Maintained)  
**HE** (Vehicle Type: Heavy Equip, Automotive Equip,  
 (Seasonal Equip, Generators))  
**Start/10:55** (Start Time)  
**End/3:50** (End Time)  
**Maintenance/Unit level** Maintenance Type: Unit or Support)

Sequence No.	Time	Category*	Description	Comments
1	1.60	IP	move vehicles	got work order earlier from operator/see #36 from earlier same day
2	1.20	NP	walk to parts inventory	
3	7.30	P	obtain parts	
4	0.55	NP	complete parts inventory forms	
5	0.54	NP	walk from parts inventory	
6	4.50	P	repair	lights checked
7	0.35	NP	walk to parts inventory	
8	0.30	P	obtain parts	
9	0.35	NP	walk from parts inventory	
10	9.70	P	repair	
11	0.80	NP	discard replaced parts	oil
12	37.60	P	repair	gauge replaced/begin tredle valve job
13	1.45	NP	clean hands	
14	54.00	NP	lunch break	colonel spoke
15	23.60	P	repair	tredle valve
16	4.80	NP	give assistance	plumber checking on work order
17	2.00	P	repair	
18	0.20	NP	walk to/from tools	
19	0.05	IP	select tools	
20	0.25	NP	walk to/from tools	
21	23.00	P	repair	
22	1.60	NP	walk to parts inventory	
23	2.35	P	obtain parts	couldn't find part
24	0.80	NP	look for a similar part	
25	0.40	NP	walk from parts inventory	
26	2.00	P	repair	
27	1.00	NP	give assistance	
28	7.70	P	repair	
29	0.30	NP	walk to/from tools	

\*P = Productive.

NP = Nonproductive.

IP = Indirect productive.

Table C2 (Cont'd)

Sequence No.	Time	Category*	Description	Comments
30	0.10	IP	select tools	
31	0.35	NP	walk to/from tools	
32	17.50	P	repair	
33	1.30	NP	clean hands	
34	15.80	NP	coffee break	
35	11.00	P	repair	
36	0.45	NP	walk to parts inventory	
37	4.70	NP	talk to inventory control clerk	
38	0.45	NP	walk from parts inventory	
39	29.80	P	repair	
40	0.20	NP	walk to/from tools	
41	0.10	IP	select tools	
42	0.20	NP	walk to/from tools	
43	3.50	P	repair	
44	0.35	NP	walk to/from tools	
45	0.25	IP	select tools	
46	0.40	NP	walk to/from tools	
47	11.50	P	repair	
48	4.50	IP	clean work area	
49	0.50	NP	complete LE form	
50	2.45	NP	clean hands	

END OF DAY

\*P = Productive.

NP = Nonproductive.

IP = Indirect productive.

## APPENDIX D: TASK DESCRIPTION OF 10 VEHICLES WITH THE HIGHEST NUMBER OF REPAIR TASKS PERFORMED

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
2	0316-6	M Maint	2	1904-6	Adjust ball joint linkage
2	0316-6	M-Maint	2	1904-6	Replace ball joint
2	0316-6	Repair mirror	2	1904-6	Rpl ball joint
2	0316-6	Replace brake lite bulbs	2	1919-6	Replace tire
2	0316-6	Replace defroster	2	1919-6	Rpl tire
2	0316-6	Replace fan belts	2	2518-6	M Maint
2	0316-6	Replace fuel sender switch	2	2518-6	M-Maint
2	0366-6	Bleed brakes	2	2518-6	Replace tire
2	0366-6	Repair brake line	2	2883-6	Q-Maint
2	0366-6	Service Call	2	2883-6	Q-Maint
2	3366-6	Service call	2	2967-6	Replace rim assembly
2	0536-6	Checked U joints	2	2967-6	Rpl rim assembly
2	0536-6	M Maint	2	3117-6	Repair level control
2	0536-6	M-Maint	2	3117-6	Rpr level control
2	0536-6	Repair starter wire	2	3242-6	M Maint
2	0623-6	Repair air system	2	3242-6	M-Maint
2	0623-6	Rpr air system	2	3242-6	Repair transmisson rear output
2	0641-6	Drain water in tank	2	3242-6	Replace air cleaner
2	0641-6	Service Call	2	3242-6	Replace cushion assembly
2	0641-6	Service call	2	3242-6	Replace engine coolant
2	0641-6	Service treddle valve	2	3242-6	Replace engine oil
2	0721-6	Repair tire	2	3242-6	Replace engine oil filter
2	0721-6	Service Call	2	3242-6	Replace fuel filter
2	0721-6	Service call	2	3242-6	Replace fuel filters
2	0760-6	Repair door lock	2	3242-6	Replace hydraulic oil
2	0760-6	Rpr Door Lock	2	3242-6	Replace spider bearing assembly
2	0768-6	Adjust bucket levelers	2	3242-6	Replace tooth tip
2	0768-6	Check for hydraulic leaks	2	3874-6	Repair tire
2	0768-6	Repair wiring on brake lights	2	3874-6	Service Call
2	0768-6	Repair wiring on tail lights	2	3874-6	Service call
2	0768-6	Replace bulbs	2	9999-9	Repair lift lever
2	0768-6	Rpr wiring	2	9999-9	Rpr lift lever
2	0876-6	Checked for hydraulic leaks	9	0061-6	Q-Maint
2	0876-6	Q-Maint	9	0061-6	Q-Maint
2	0876-6	Q-Maint	9	0061-6	Replace master cylinder
2	1010-6	Bleed brakes	9	0093-6	Adjust left and right chain
2	1010-6	Bleed brakes	9	0093-6	Repair drive chain left side
2	1010-6	Remove and install bleeders	9	0093-6	Replace link
2	1010-6	Repair brakes	9	0093-6	Service Call
2	1062-6	M Maint	9	0093-6	Service call
2	1062-6	M-Maint	9	0312-6	Replace tire 700x15
2	1062-6	Repair hydraulic hose	9	0312-6	Replace tube
2	1062-6	Replace bucket edge	9	0312-6	Rpl tire
2	1062-6	Replace bulb	9	0460-6	Repair flasher unit
2	1062-6	Replace dipstick	9	0460-6	Replace 3 prong switch
2	1062-6	Replace headlight	9	0460-6	Replace flasher
2	1062-6	Replace headlight arrangement	9	0460-6	Replace wiring
2	1062-6	Replace teeth	9	0460-6	Rpr flasher unit
2	1062-6	Replace teeth pin	9	0456-6	Adjust points and carburetor
2	1062-6	Replace tire	9	0456-6	Bleed brake system
2	1062-6	Replace washers	9	0456-6	Checked electrical wiring
2	1399-6	Bleed brakes	9	0456-6	Cleaned inside of engine compar
2	1399-6	M Maint	9	0456-6	Fixed wires on brake cylinders
2	1399-6	M-Maint	9	0456-6	Replace belt water pump
2	1399-6	Repair air line	9	0456-6	Replace chain main broom drive
2	1399-6	Replace brake cylinder group	9	0456-6	Replace chain main drive
2	1399-6	Replace bucket pivot pins	9	0456-6	Replace engine oil filter
2	1399-6	Replace tail light assembly	9	0456-6	Replace hydraulic filter
2	1399-6	Replace tire	9	0456-6	Replace main broom wafers
2	1399-6	Steam clean vehicle	9	0456-6	Replace seal quad
2	1626-6	Repair tire	9	0456-6	Replace sprocket bushing
2	1626-6	Replace valve stem	9	0456-6	Replace sprocket drive wheel
2	1626-6	Rpr tire	9	0456-6	Replace sprocket front drive
2	1684-6	Clean plug	9	0456-6	Rpr points/carburetor
2	1684-6	Weld bucket	9	0456-6	Weld main broom lug
2	1702-6	Install registration numbers	9	0912-6	Adjust brake
2	1702-6	Q-Maint	9	0912-6	Adjust brake hydrovac
2	1702-6	Q-Maint	9	1035-6	Adjust hydraulic controls
2	1702-6	Repair rear glass frame	9	1035-6	Q-Maint
2	1702-6	Replace brake lite switch	9	1035-6	Q-Maint
2	1702-6	Replace door glass	9	1035-6	Replace hydraulic hose fittings

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
9 1035-6		Replace hydraulic hose	9 2222-6		Replace universal coupling
9 1035-6		Replace hydraulic oil	9 2222-6		Replace wheel
9 1035-6		Replace hydrovac cylinder(warra	9 2222-6		Rpl wheel
9 1035-6		Replace points	9 2704-6		Q-Maint
9 1035-6		Replace side broom	9 2704-6		Q-Maint
9 1239-6		Repair detent assembly	9 2704-6		Replace condensor
9 1239-6		Replace caution sign	9 2704-6		Replace plugs
9 1239-6		Replace left and right door gla	9 2704-6		Replace points
9 1239-6		Rpr detent assembly	9 2704-6		Replace side broom
9 1542-6		Repair stabilizer bar	9 3104-6		Adjust side and main broom chai
9 1542-6		Repair tire	9 3104-6		Adjust side broom cable
9 1542-6		Replace wiper motor	9 3104-6		Replace clearance lite markers
9 1542-6		Rpr tire	9 3104-6		Replace headlight
9 1575-6		Adjust clutch return spring	9 3104-6		Replace left hand rubber shoes
9 1575-6		Realign brake	9 3104-6		Replace left hand shoe assembly
9 1575-6		Realigned brake	9 3104-6		Replace lft hand rubber brg sto
9 1575-6		Repair stabilizer	9 3104-6		Replace main broom
9 1575-6		Replace clutch master cylinder	9 3104-6		Replace signal flasher
9 1575-6		Replace clutch slave cylinder	9 3104-6		Replace stop lite switch
9 1718-6		Replace side broom	9 3104-6		Replace switch assembly
9 1718-6		Service Call	9 3104-6		Replace tail and stop lite asse
9 1822-6		Adjust dirt shoe	9 3104-6		Replace turn signal switch asse
9 1822-6		Repair side broom guide	9 3104-6		Rpl main broom
9 1822-6		Replace 700x15HT tire	9 3224-6		Replace runner shoes
9 1822-6		Replace main broom	9 3224-6		Replace side broom
9 1822-6		Replace shoe runner front	9 3224-6		Rpl runner shoes
9 1822-6		Replace shoe runner rear	9 3460-6		Repair wiper motor aim
9 1822-6		Replace side broom	9 3651-6		Rpr tire
9 1822-6		Weld side broom bolt	9 3651-6		Repair rear tires
9 1867-6		Adjust slave cylinder linkage	9 3685-6		Replace main broom
9 1867-6		Repair slave cylinder bracket	9 3685-6		Replace rear tire
9 1867-6		Replace slave cylinder	9 3685-6		Replace rear wheel 15"
9 1867-6		Rpl fuel pump	9 3685-6		Replace side broom
9 1899-6		Bleed brakes	9 3685-6		Replace tube
9 1899-6		Install left rearview mirror	9 3685-6		Rpr tires
9 1899-6		Lubricate vehicle	10 0095-6		Repair tire
9 1899-6		Repair steering	10 0095-6		Repair tube 700x15
9 1899-6		Repair turn signal lever	10 0095-6		Rpr Tire
9 1899-6		Repair wiring	10 0116-6		Replace headlight
9 1899-6		Replace brake fluid	10 0116-6		Replace main broom
9 1899-6		Replace engine oil	10 0116-6		Replace main broom drive sprock
9 1899-6		Replace engine oil filter	10 0116-6		Replace main broom rear sprocke
9 1899-6		Replace indicator bulb	10 0116-6		Replace runner dirt shoe
9 1899-6		Replace intake gasket	10 0116-6		Replace signal flasher
9 1899-6		Replace push rod gasket	10 0116-6		Rpl main broom
9 1982-6		Replace main broom drum	10 0477-6		Q-Maint
9 1982-6		Replace main broom side shaft b	10 0477-6		Q-Maint
9 1982-6		Rpl main broom	10 0477-6		Replace clearance lights
9 2222-6		Replace bolt and bushings side	10 0477-6		Replace emergency brake band
9 2222-6		Replace clutch disc assembly	10 0477-6		Replace emergency brake drum
9 2222-6		Replace emergency brake band	10 0477-6		Replace exhaust manifold gasket
9 2222-6		Replace engine oil filter	10 0477-6		Replace master cylinder clutch
9 2222-6		Replace engine thermostat	10 0477-6		Replace headlight
9 2222-6		Replace hydraulic filter	10 0647-6		Rpl headlight
9 2222-6		Replace oil pan gasket	10 0647-6		Q-Maint
9 2222-6		Replace pilot bearing fly wheel	10 0668-6		Q-Maint
9 2222-6		Replace pivot gear housing uppe	10 0668-6		Repair and reseal broom transfe
9 2222-6		Replace pivot shaft bearing sid	10 0668-6		Repair side window channels
9 2222-6		Replace pressure plate	10 0668-6		Replace main broom drive chain
9 2222-6		Replace seal	10 0668-6		Replace main broom drive sprock
9 2222-6		Replace seal side broom	10 0668-6		Replace side broom drive sprock
9 2222-6		Replace seals side broom gear b	10 0668-6		Weld water tank
9 2222-6		Replace shaft upper side broom	10 1147-6		Weld water tank
9 2222-6		Replace side broom bolt	10 1153-6		Replace hour meter
9 2222-6		Replace side broom bottom shaft	10 1153-6		Rpl hour meter
9 2222-6		Replace side broom drive shaft	10 1189-6		Replace side broom
9 2222-6		Replace side broom intermediate	10 1189-6		Rpl side broom
9 2222-6		Replace side broom rack	10 1249-6		Repair cam arm main broom
9 2222-6		Replace side broom sprocket	10 1249-6		Repair dirt guard
9 2222-6		Replace sleeve assy throw out b	10 1249-6		Replace main broom
9 2222-6		Replace tire 600x15			

FEN#	DOC #	DESCRIPTION	FEN#	DOC #	DESCRIPTION
10	1249-6	Replace main broom core	15	0172-6	Service call
10	1249-6	Rpr cam arm	15	0378-6	Repair starter solenoid wire
10	1450-6	Adjust clutch	15	0378-6	Service Call
10	1450-6	Adjust steering	15	0378-6	Service call
10	1450-6	Install sheet metal	15	0463-6	Replace tilt cylinder hose on b
10	1450-6	Q-Maint	15	0463-6	Rpl tilt cyl
10	1450-6	Q-Maint	15	0775-6	Service Call
10	1450-6	Repair tire	15	0775-6	Service call
10	1450-6	Replace clutch disk	15	0880-6	Adjust brakes
10	1450-6	Replace drive chain side broom	15	0880-6	Q-Maint
10	1450-6	Replace drive sprocket	15	0880-6	Q-Maint
10	1450-6	Replace main broom drive chain	15	0880-6	Replace end bits
10	1450-6	Replace main broom drive shaft	15	0880-6	Rotate cutting edges
10	1450-6	Replace main broom drive sprock	15	0913-6	Adjust arm
10	1450-6	Replace pilot bearing	15	0913-6	Adjust arm
10	1450-6	Replace pressure plate	15	0913-6	Remove and install dozer arm
10	1450-6	Replace PTO assembly	15	0913-6	Replace bits
10	1450-6	Replace side broom drive sprock	15	0913-6	Weld dozer arm
10	1450-6	Replace throw out bearing	15	1068-6	Replace transmission oil
10	1450-6	Replace thrust washer side broo	15	1068-6	Replace transmission oil filter
10	1450-6	Replace transmission	15	1068-6	Service Call
10	1450-6	Steam clean vehicle	15	1068-6	Service call
10	1544-6	Repair tire	15	1411-6	Service Call
10	1544-6	Rpr tire	15	1411-6	Service call
10	2340-6	Repair beacon light	15	1430-6	Replace hose and fittings
10	2340-6	Replace side broom shear pin	15	1430-6	Rpl hose
10	2340-6	Rpr beacon light	15	1494-6	Adjust all belts
10	2705-6	Replace condensor	15	1494-6	Service Call
10	2705-6	Replace ignition points	15	1494-6	Service call
10	2705-6	Replace main broom	15	1607-6	Adjust center arm
10	2705-6	Replace plugs	15	1607-6	Adjust dozer arm pins
10	2705-6	Rpl points & plugs	15	1607-6	Adjust dozer arm shims
10	2941-6	Adjust carb	15	1607-6	Install dozer arm caps
10	2941-6	Q-Maint	15	1607-6	Repair lock bolts and brackets
10	2941-6	Q-Maint	15	1607-6	Replace bolts
10	2941-6	Replace bulb	15	1607-6	Rpl bolt
10	2941-6	Replace carburetor	15	1710-6	Service call
10	2941-6	Replace drive chain side broom	15	1710-6	Adjust brakes
10	2941-6	Replace main broom	15	1710-6	Q-Maint
10	2941-6	Replace main broom drive chain	15	1710-6	Q-Maint
10	2941-6	Replace main broom shaft bearin	15	1710-6	Repair rock guards
10	2941-6	Replace runner dirt shoe	15	1710-6	Replace hydraulic hose tilt
10	2941-6	Replace side broom	15	1710-6	Replace hydraulic lift cylinder
10	2941-6	Replace side broom gear	15	1710-6	Service call
10	2941-6	Replace transfer gear box oil	15	1750-6	Adjust brakes
10	2941-6	Replace transfer gear box seal	15	1750-6	Service Call
10	3384-6	Adjust emerg brake	15	1750-6	Service call
10	3384-6	Adjust emergency brake	15	2078-6	Repair wire
10	3384-6	Replace alternator	15	2078-6	Service Call
10	3384-6	Replace hydraulic hoses	15	2078-6	Service call
10	3384-6	Replace hydraulic oil	15	2329-6	Q-Maint
10	3384-6	Replace side broom	15	2329-6	Replace left dozer bit
10	3384-6	Steam clean vehicle	15	2329-6	Replace lift cylinder pivot bea
10	3660-6	Repair rear tires	15	2379-6	Adjust steering linkage
10	3660-6	Replace gear box oil	15	2379-6	Adjust steering linkage
10	3660-6	Replace hydraulic pump	15	2379-6	Check charging system
10	3660-6	Replace rear tire	15	2379-6	Replace pin
10	3660-6	Replace rear wheel	15	2379-6	Replace roller bearing
10	3660-6	Replace side broom	15	2379-6	Service call
10	3660-6	Replace side broom seals	15	2449-6	Realign rear broom
10	3660-6	Replace side broom shaft lower	15	2449-6	Replace O-ring packing preforme
10	3660-6	Replace side broom shaft upper	15	2449-6	Replace transmission fluid
10	3660-6	Replace side broom u-joint	15	2449-6	Replace transmission hose
10	3660-6	Replace side clearance lens	15	2449-6	Service call
10	3660-6	Replace tube	15	2501-6	Repair fuel line
10	3660-6	Replace woodruff key size G	15	2501-6	Service call
10	3660-6	Rpr tire/wheel	15	2501-6	S-Maint
10	3740-6	Repair tire	15	2585-5	Replace plug
10	3740-6	Rpr tire	15	2585-5	Rpl plug
15	0172-6	Repair track	15	2586-6	Q-Maint
15	0172-6	Service Call	15	2586-6	Q-Maint

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
15	2586-6	Reinstall cylinder heads (rebui	18	1048-6	Rpl main broom
15	2586-6	Remove and install belly pan	18	1188-6	Repair indicator cable
15	2586-6	Remove and install radiator fan	18	1188-6	Rpr ind cable
15	2586-6	Remove, clean and install radia	18	1230-6	Install hour meter
15	2586-6	Replace 4-1/2" tubing	18	1230-6	Instl hour meter
15	2586-6	Replace bridge clamp	18	1230-6	Repair alternator wiring
15	2586-6	Replace cap air cleaner	18	1230-6	Repl ce alternator
15	2586-6	Replace clamp	18	1230-6	Replace spark plug
15	2586-6	Replace coupling	18	1340-6	Adjust conveyor belt
15	2586-6	Replace cover bearing	18	1340-6	Adjust conveyor belt bearings
15	2586-6	Replace cylinder head gaskets	18	1340-6	Replace battery
15	2586-6	Replace element breather	18	1340-6	Replace distributor cap
15	2586-6	Replace exhaust stud to head	18	1340-6	Troubleshoot generator system
15	2586-6	Replace ferrule grooved	18	1441-6	Adjust clutch
15	2586-6	Replace fuel pressure gage	18	1441-6	Adjust clutch
15	2586-6	Replace gasket	18	1441-6	Realign rear broom chain
15	2586-6	Replace gasket exhaust manifold	18	1441-6	Reconnect alternator leads
15	2586-6	Replace gasket intake manifold	18	1441-6	Repair side broom chain
15	2586-6	Replace line assembly	18	1441-6	Replace side broom shear pin
15	2586-6	Replace locking plate	18	1501-6	Replace tube
15	2586-6	Replace magnet	18	1501-6	Rpl tube
15	2586-6	Replace O-ring	18	1535-6	Repair tire
15	2586-6	Replace packing preformed	18	1535-6	Rpr tire
15	2586-6	Replace pump oil transmission	18	1576-6	Checked hydraulics
15	2586-6	Replace push rod gasket complet	18	1576-6	Checked hydraulics
15	2586-6	Replace screen	18	1576-6	Replace chain drive belt
15	2586-6	Replace seal	18	1576-6	Replace hydraulic filter
15	2586-6	Replace seal plain encased	18	1593-6	Lubricate
15	2586-6	Replace seal ring metal	18	1593-6	Repair clutch
15	2586-6	Replace strainer assembly	18	1593-6	Replace hydraulic hose
15	2586-6	Replace thermostat	18	1593-6	Replace slave bracket
15	2586-6	Replace tube clamp	18	1593-6	Weld pressure plate
15	2586-6	Replace turbo charger assembly	18	1648-6	Bleed injectors
15	2586-6	Replace valve check	18	1648-6	Repair side broom guides
15	2586-6	Replace water distributor ferru	18	1648-6	Weld side broom guide pin
15	2586-6	Replace water distributor gaske	18	1839-6	Adjust dirt shoe
15	2586-6	Steam clean vehicle	18	1839-6	Repair dirt shoe
15	2586-6	Welding on tractor	18	1839-6	Repair guide bracket bolt
15	2879-6	Installed hydraulic lines for d	18	1839-6	Replace bolts in dirt shoe brac
15	2879-6	Inst/Rpl hydraulic lines	18	1839-6	Rpl pivot pin
15	2879-6	Remove & install frt grill, flo	18	2010-6	Adjust clutch
15	2879-6	Remove & install hood, exh stk,	18	2010-6	Adjust steering
15	2879-6	Replace alternator belt	18	2010-6	Align side broom
15	2879-6	Replace hydraulic oil	18	2010-6	Q-Maint
15	2889-6	Adjust fan belts	18	2010-6	Replace electrical terminals
15	2889-6	Adjust tracks	18	2010-6	Replace head light seal beam
15	2889-6	Install hyd lines for disconnect	18	2010-6	Replace main drive chain
15	2889-6	Install hydraulic quick disconn	18	2010-6	Replace main drive sprockets
15	2889-6	Plug hydraulic hose tilt	18	2010-6	Replace side light seal beam
15	2889-6	Q-Maint	18	2010-6	Replace turn signal assembly
15	2889-6	Q-Maint	18	2242-6	Repair tire
15	2889-6	Repair breather stack	18	2242-6	Rpr tire
15	2889-6	Repair door to track adj zert	18	2300-6	Align side broom
15	2889-6	Repair exhaust elbow and flange	18	2300-6	Align side broom rails
15	2889-6	Replace alternator belt	18	2300-6	Replace antifreeze
15	2889-6	Replace winch cable	18	2300-6	Replace condensor
15	2889-6	Replace winch oil	18	2300-6	Replace conveyor belt
15	2889-6	Weld hand rail	18	2300-6	Replace distributor point set
15	2889-6	Welded dirt guard brackets	18	2300-6	Replace lower conveyor roller b
15	2910-6	Repair headache rack (weld)	18	2300-6	Replace spark plug
15	2910-6	Replace oil switch	18	2300-6	Weld side broom guides
15	2910-6	Replace winch control cable	18	2312-6	Adjust emergency brake
15	2910-6	Service Call	18	2312-6	Adjust emergency brake
15	2910-6	Service call	18	2312-6	Adjust steering linkage
15	3565-6	Replace hose	18	2428-6	Engine compression test
15	3565-6	Service Call	18	2428-6	Realign rear broom
15	3565-6	Service call	18	2428-6	Remove and install side broom g
15	3565-6	Repair fuel line	18	2428-6	Replace engine oil
15	3565-6	Service Call	18	2428-6	Replace engine oil filter
15	3565-6	Service call	18	2428-6	Replace seal beam
18	1048-6	Replace main broom	18	2428-6	Replace side broom coupling u-j

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
18	2428-6	Replace spark plug	365	0336-6	Replace adapter alcohol bottle
18	2428-6	Service Call	365	0336-6	Replace air comp base gasket
18	2428-6	Weld side cylinder pin	365	0336-6	Replace air comp base gasket
18	2666-6	Adjust engine timing	365	0336-6	Replace alternator
18	2666-6	Replace copper fuel hose	365	0336-6	Replace alternator
18	2666-6	Replace electrical connectors	365	0336-6	Replace clutch
18	2666-6	Replace engine oil	365	0336-6	Replace clutch
18	2666-6	Replace engine oil filter	365	0336-6	Replace defroster hose
18	2666-6	Replace fuel pump	365	0336-6	Replace defroster hose
18	2666-6	Replace hose clamps	365	0336-6	Replace fan belt
18	2666-6	Replace inline fuel filter	365	0336-6	Replace fan belt
18	2666-6	Replace main broom	365	0336-6	Replace flasher
18	2666-6	Replace side broom chain	365	0336-6	Replace flasher
18	2666-6	Replace spark plug	365	0336-6	Replace injector
18	2666-6	Rpr Engine	365	0336-6	Replace injector
18	3126-5	Install 1/4 flatwashers	365	0336-6	Replace oil line
18	3126-5	Install 1/4 hex nuts	365	0336-6	Replace oil switch
18	3126-5	Install 1/4 lockwashers	365	0336-6	Replace oil switch
18	3126-5	Install 1/4x1/2 cap screws	365	0336-6	Replace transmisson oil
18	3126-5	Install conveytor belt	365	0336-6	Replace transmisson oil
18	3126-5	Install main broom	365	0764-6	Adjust tailgate clamps
18	3126-5	Q-Maint	365	0764-6	Adjust tailgate clamps
18	3126-5	Q-Maint	365	0764-6	Repair tailgate chains
18	3126-5	Repair light system	365	0764-6	Repair tailgate chains
18	3126-5	Repair point system	365	0764-6	Rpr Tailgate Chains
18	3126-5	Replace alternator	365	0788-6	Replace batteries
18	3126-5	Replace battery	365	0788-6	Replace batteries
18	3126-5	Replace cap screw	365	0788-6	Service Call
18	3126-5	Replace convertor deflector lef	365	0788-6	Service call
18	3126-5	Replace convertor deflector rig	365	0788-6	Service call
18	3126-5	Replace dirt shoe extension spr	365	0839-6	Charge Batteries
18	3126-5	Replace external side broom rin	365	0839-6	Charge batteries
18	3126-5	Replace flange bearing over rot	365	0839-6	Charge batteries
18	3126-5	Replace flasher	365	0885-6	Repair tire
18	3126-5	Replace fuel pump	365	0885-6	Repair tire
18	3126-5	Replace jack shaft side broom r	365	0885-6	Rpr Tire
18	3126-5	Replace master cylinder brake	365	0897-6	Weld Headache Rack
18	3126-5	Replace master cylinder clutch	365	0897-6	Weld headache rack
18	3126-5	Replace pivot gear hsing sb upp	365	0897-6	Weld headache rack
18	3126-5	Replace pivot housing side broo	365	0910-6	Repair power steering hose
18	3126-5	Replace pivot housing side broo	365	0910-6	Repair power steering hose
18	3126-5	Replace seal	365	0910-6	Replace steering fluid
18	3126-5	Replace seal input shaft	365	0910-6	Replace steering fluid
18	3126-5	Replace side broom chain sprock	365	0910-6	Rpr PS Hose
18	3126-5	Replace side broom pivot housin	365	0920-6	Repair wheel (loose)
18	3126-5	Replace side broom seal	365	0920-6	Repair wheel (loose)
18	3126-5	Replace side broom spring	365	0920-6	Replace tire
18	3126-5	Replace side lights	365	0920-6	Replace tire
18	3126-5	Replace signal flasher	365	0920-6	Rpr Wheel
18	3126-5	Replace sprocket side broom dri	365	0920-6	Weld chain holder
18	3126-5	Replace turn signal assembly	365	0920-6	Weld chain holder
18	3126-5	Replace wafer core	365	0920-6	Weld tailgate
18	3126-5	Replace wiper clamp	365	0920-6	Weld tailgate
18	3126-5	Replace wiper convertor deflect	365	0935-6	Charge Battery
18	3126-5	Weld hopper door brace	365	0935-6	Charge battery
18	3409-6	Replace fittings	365	0935-6	Charge battery
18	3409-6	Replace hydraulic hose	365	0935-6	Start truck
18	3409-6	Rpl fittings/hose	365	0935-6	Start truck
18	3409-6	Steam clean	365	0935-6	Repair tire
18	3673-6	Repair tire	365	1040-6	Repair tire
18	3673-6	Rpr Tire	365	1040-6	Repair tire
365	0336-6	L Maint	365	1040-6	Rpr Tire
365	0336-6	L Maint	365	1044-6	Repair/align tailgate
365	0336-6	L Maint	365	1044-6	Repair/align tailgate
365	0336-6	Repair air tank	365	1044-6	Replace bulb
365	0336-6	Repair air tank	365	1044-6	Replace bulb
365	0336-6	Repair horn button	365	1044-6	Rpr/Align Tailgate
365	0336-6	Repair horn button	365	1054-6	Adjust clutch
365	0336-6	Repair idler arm	365	1054-6	Adjust clutch
365	0336-6	Repair idler arm	365	1054-6	Grease front end
365	0336-6	Replace adapter alcohol bottle	365	1054-6	Grease front end

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
365	1054-6	Repair tie rod	365	1834-6	Replace fuel filter
365	1054-6	Repair tie rod	365	1865-6	Rpr Muffler
365	1054-6	Rpr Tie Rod	365	1937-6	Replace U-joint
365	1054-6	Weld chain holder	365	1937-6	Service Call
365	1054-6	Weld chain holder	365	1937-6	Service call
365	1178-6	A Maint	365	1973-6	Repair muffler
365	1178-6	A Maint	365	1973-6	Rpr Muffler
365	1178-6	A Maint	365	1995-6	Replace exhaust/muffler
365	1178-6	Repair engine stop cable	365	1995-6	Rpl Exhaust/Muffler
365	1178-6	Repair engine stop cable	365	2094-6	Replace pod
365	1178-6	Repair PTO U-joint	365	2094-6	Rpl Pod
365	1178-6	Repair PTO U-joint	365	2113-6	Repair tire
365	1178-6	Repair wiring	365	2113-6	Rpr Tire
365	1178-6	Repair wiring	365	2130-6	Adjust clutch
365	1178-6	Replace backup switch	365	2130-6	Check front end
365	1178-6	Replace backup switch	365	2130-6	Check rear spring bolt
365	1178-6	Replace hoist zert	365	2130-6	Replace tire
365	1178-6	Replace hoist zert	365	2130-6	Rpl Tire
365	1178-6	Replace PTO packing	365	2228-6	L Maint
365	1178-6	Replace PTO packing	365	2228-6	L Maint
365	1178-6	Replace window handle crank	365	2228-6	Repair engine stop cable
365	1178-6	Replace window handle crank	365	2228-6	Repair spring
365	1243-6	Lubricate	365	2228-6	Replace front sheet lug studs
365	1243-6	Lubricate	365	2228-6	Replace front wheel lug nut
365	1243-6	Misc Mower Rpr	365	2228-6	Replace L/F spring center bolt
365	1243-6	Replace air pot	365	2280-6	Weld Tailgate/Bracket
365	1243-6	Replace air pot	365	2280-6	Weld tailgate/bracket
365	1243-6	Replace blower motor	365	2304-6	Repair exhaust pipe
365	1243-6	Replace blower motor	365	2304-6	Repair right door
365	1243-6	Replace leaf spring	365	2304-6	Replace starter
365	1243-6	Replace leaf spring	365	2304-6	Rpl Starter
365	1243-6	Replace rear spring	365	2321-6	Check front end
365	1243-6	Replace rear spring	365	2321-6	Repair L/Front wheel bearing
365	1243-6	Replace rear spring bolt	365	2321-6	Repair spring shackle
365	1243-6	Replace rear spring bolt	365	2321-6	Repair tailgate
365	1243-6	Replace rear spring bracket	365	2321-6	Repair tire
365	1243-6	Replace rear spring bracket	365	2321-6	Rpr Tailgate
365	1243-6	Replace rear wheel seal	365	2589-6	Repair tires
365	1243-6	Replace rear wheel seal	365	2589-6	Service Call
365	1243-6	Replace spider	365	2589-6	Service call
365	1243-6	Replace spider	365	3060-6	Reweld Headache Rack
365	1243-6	Weld rear spring bracket	365	3060-6	Reweld headache rack
365	1243-6	Weld rear spring bracket	365	3075-6	Repair tire
365	1541-6	Align Brake Can	365	3075-6	Rpr Tire
365	1541-6	Align brake can	365	3105-6	Adjust clutch
365	1541-6	Align brake can	365	3105-6	Replace fuel filters
365	1594-6	Repair battery cable	365	3105-6	Replace fuse
365	1594-6	Repair battery hold down	365	3105-6	Rpl Fuel Filters
365	1594-6	Replace batteries	365	3182-6	Reface flywheel
365	1594-6	Replace bulb	365	3182-6	Repair air tank
365	1594-6	Rpl Batteries	365	3182-6	Repair ether bottle bracket
365	1632-6	Fabricate new tailgate	365	3182-6	Replace clutch
365	1632-6	Repair fuel tank	365	3182-6	Replace grease zerk
365	1632-6	Repair PTO shaft	365	3182-6	Replace transmission
365	1632-6	Replace clutch	365	3182-6	S Maint
365	1632-6	Replace front spring	365	3182-6	S Maint
365	1632-6	Replace PTO shaft seal	365	3221-6	Repair wiring to fuel oil sende
365	1632-6	Replace transmission	365	3221-6	Service Call
365	1632-6	Replace transmission fluid	365	3221-6	Service call
365	1632-6	Rpr PTO Shaft	365	3253-6	Repair electrical connection
365	1647-6	Weld Rack	365	3253-6	Service Call
365	1647-6	Weld rack	365	3253-6	Service call
365	1686-6	Repair muffler	365	3301-6	Add transmisson oil
365	1686-6	Repair tire	365	3301-6	Adj Clutch
365	1686-6	Replace backup alarm	365	3301-6	Adjust clutch
365	1686-6	Replace bulb	365	3301-6	Tighten speedometer cable
365	1686-6	Replace rear center spring bolt	365	3385-6	Greased bed/springs
365	1686-6	Weld Muffler	365	3385-6	Replace bulb
365	1686-6	Weld muffler	365	3385-6	Replace pins
365	1834-6	Repair bumper	365	3385-6	Replace spring
365	1834-6	Repair muffler	365	3385-6	Replace U-bolts

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
367	0880-6	Repair tailgate	365	3385-6	Rpl Spring
367	0880-6	Repair temperature gage	365	3569-6	Add oil
367	0880-6	Repair temperature gage	365	3569-6	Check oil pressure
367	0880-6	Repair tire	365	3569-6	Checked wiring
367	0880-6	Repair tire	365	3569-6	Replace bulb
367	0880-6	Replace fuel filter	365	3569-6	Replace oil pressure gage (used
367	0880-6	Replace fuel filter	365	3569-6	Replace oil sending unit
367	0880-6	Replace PTO U-jopint	365	3569-6	Rpl Oil Sending Unit
367	0880-6	Replace PTO U-jopint	365	3682-6	Fabricate pin for tailgate
367	0880-6	Replace speedometer cable	365	3682-6	Repair rear springs
367	0880-6	Replace speedometer cable	365	3682-6	Repair tailgate
367	0880-6	Replace transmisson	365	3682-6	Replace brake valve (off 367)
367	0880-6	Replace transmisson	365	3682-6	Replace rear spring bolts
367	0880-6	Rpl Transmission	365	3682-6	Rpr Tailgate
367	1045-6	Repair/align tailgate	365	3682-6	Weld hanger
367	1045-6	Repair/align tailgate	365	3768-6	Repair tire
367	1045-6	Replace bulb	365	3768-6	Rpr Tire
367	1045-6	Replace bulb	365	3950-6	Adjust front brake pad
367	1045-6	Replace shaft pins	365	3950-6	Replace copper tubing
367	1045-6	Replace shaft pins	365	3950-6	Rpl Copper Tubing
367	1045-6	Replace tailgate pins	367	0020-6	A Maint
367	1045-6	Replace tailgate pins	367	0020-6	A Maint
367	1045-6	Rpr/Align Tailgate	367	0020-6	A Maint
367	1248-6	Replace heater motor (off 365)	367	0020-6	Manufactured snow plow mount
367	1248-6	Replace heater motor (off 365)	367	0020-6	Manufactured snow plow mount
367	1248-6	Rpl Heater Motor	367	0020-6	Replace bulb
367	1258-6	Repair engine shut off	367	0020-6	Replace bulb
367	1258-6	Repair engine shut off	367	0020-6	Replace rear wheel seal
367	1258-6	Repair tire	367	0020-6	Replace rear wheel seal
367	1258-6	Repair tire	367	0194-6	Replace tire
367	1258-6	Replace tire	367	0194-6	Replace tire
367	1258-6	Replace tire	367	0194-6	Rpl Tire
367	1258-6	Weld Tailgate	367	0455-6	Add transmisson oil
367	1258-6	Weld tailgate	367	0455-6	Add transmisson oil
367	1258-6	Weld tailgate	367	0455-6	Replace clutch
367	1346-6	Replace tire	367	0455-6	Replace clutch
367	1346-6	Replace tire	367	0455-6	Replace seals in PTO
367	1346-6	Rpl Tires	367	0455-6	Replace seals in PTO
367	1419-6	Adjust tailgate latches	367	0455-6	Replace tie rod
367	1419-6	Adjust tailgate latches	367	0455-6	Replace tie rod
367	1419-6	Repair tailgate	367	0455-6	Replace transmisson
367	1419-6	Repair tailgate	367	0455-6	Replace transmisson
367	1419-6	Rpr Tailgate	367	0455-6	Rpl Transmission
367	1420-6	Repair tailgate linkage	367	0558-6	Repair heater wire
367	1420-6	Repair tailgate linkage	367	0558-6	Repair heater wire
367	1420-6	Rpr Tailgate Linkage	367	0558-6	Repair PTO key
367	1443-6	Repair tire	367	0558-6	Repair PTO key
367	1443-6	Repair tire	367	0558-6	Repair PTO U-joint
367	1443-6	Rpr Tire	367	0558-6	Repair PTO U-joint
367	1458-6	Replace differential oil	367	0558-6	Replace battery (used)
367	1458-6	Replace differential oil	367	0558-6	Replace battery (used)
367	1458-6	Replace transmisson fluid	367	0558-6	Rpr PTO U-Joints
367	1458-6	Replace transmisson fluid	367	0615-6	Tighten Alternator Belt
367	1458-6	Rpl Transmission Oil	367	0615-6	Tighten alternator belt
367	1499-6	Repair tire	367	0615-6	Tighten alternator belt
367	1499-6	Repair tire	367	0645-6	Repair speedometer cable
367	1499-6	Replace fuel filter	367	0645-6	Repair speedometer cable
367	1499-6	Replace fuel filter	367	0645-6	Repair tire
367	1499-6	Rpr Tire	367	0645-6	Repair tire
367	1526-6	Cut ear off (tailgate)	367	0645-6	Replace fuel filter
367	1526-6	Cut ear off (tailgate)	367	0645-6	Replace fuel filter
367	1526-6	Service Batteries	367	0645-6	Rpr Speedometer Cable
367	1526-6	Service batteries	367	0710-6	Repair tire
367	1526-6	Service batteries	367	0710-6	Repair tire
367	1589-6	Repair tire	367	0710-6	Rpr Tire
367	1589-6	Repair tire	367	0801-6	Repair tire
367	1589-6	Rpr Tire	367	0801-6	Repair tire
367	1628-6	Repair tire	367	0801-6	Rpr Tire
367	1628-6	Repair tire	367	0880-6	Adjust clutch
367	1628-6	Rpr Tire	367	0880-6	Adjust clutch
367	1746-6	Fabricate new tailgate	367	0880-6	Repair tailgate

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
367	1746-6	Fabricate new tailgate	367	2450-6	Service call
367	1746-6	Misc Auto Rpr	367	2450-6	Service call
367	1746-6	Repair heads	367	2497-6	Replace antifreeze
367	1746-6	Repair heads	367	2497-6	Replace antifreeze
367	1746-6	Repair light bracket	367	2497-6	Replace radiator
367	1746-6	Repair light bracket	367	2497-6	Replace radiator
367	1746-6	Repair tail light	367	2497-6	Rpl Radiator
367	1746-6	Repair tail light	367	2712-6	Adjust brakes
367	1746-6	Repair tailgate bracket	367	2712-6	Adjust brakes
367	1746-6	Repair tailgate bracket	367	2712-6	Repair bed linkage
367	1746-6	Replace clutch pad	367	2712-6	Repair bed linkage
367	1746-6	Replace clutch pad	367	2712-6	Repair spider
367	1746-6	Replace dump linkage	367	2712-6	Repair spider
367	1746-6	Replace dump linkage	367	2712-6	Repair tie rod
367	1746-6	Replace exhaust system	367	2712-6	Repair tie rod
367	1746-6	Replace exhaust system	367	2712-6	Replace camshaft bracket (used)
367	1746-6	Replace gasket set	367	2712-6	Replace camshaft bracket (used)
367	1746-6	Replace gasket set	367	2712-6	Replace muffler
367	1746-6	Replace lamp	367	2712-6	Replace muffler
367	1746-6	Replace lamp	367	2712-6	Replace muffler clamp
367	1746-6	Replace muffler clamp	367	2712-6	Replace muffler clamp
367	1746-6	Replace muffler clamp	367	2712-6	Replace tail pipe
367	1746-6	Replace spring front	367	2712-6	Replace tail pipe
367	1746-6	Replace spring front	367	2712-6	Replace transmisson oil
367	1746-6	S Maint	367	2712-6	Replace transmisson oil
367	1746-6	S Maint	367	2712-6	Rpl Muffler/Misc Rpr
367	1746-6	Weld chain holder	367	2762-6	Repair hose
367	1746-6	Weld chain holder	367	2762-6	Repair hose
367	1752-6	Adjust door	367	2762-6	Repair injection line
367	1752-6	Adjust door	367	2762-6	Repair injection line
367	1752-6	L Maint	367	2762-6	Repair wiring
367	1752-6	L Maint	367	2762-6	Repair wiring
367	1752-6	L Maint	367	2762-6	Replace fuel filter
367	1752-6	Repair bed tailgate linkage	367	2762-6	Replace fuel filter
367	1752-6	Repair bed tailgate linkage	367	2762-6	Rpr Injection Line
367	1752-6	Repair clearance lte	367	2773-6	Overheating
367	1752-6	Repair clearance lte	367	2773-6	Overheating
367	1752-6	Replace clearance lte	367	2773-6	Overheating
367	1752-6	Replace clearance lte	367	3162-5	Repair tire
367	1752-6	Replace door	367	3162-5	Repair tire
367	1752-6	Replace door	367	3162-6	Rpr Tire
367	1752-6	Replace heat gage	367	3284-6	L Maint
367	1752-6	Replace heat gage	367	3284-6	L Maint
367	2390-6	Repair muffler	367	3284-6	L Maint
367	2390-6	Repair muffler	367	3294-6	S Maint
367	2390-6	Repair muffler bracket	367	3297-6	Replace belt tension spring
367	2390-6	Repair muffler bracket	367	3297-6	Replace belt tension spring
367	2390-6	Rpr Muffler	367	3297-6	Rpl Belt Tension Spring
367	2390-6	Weld pipe to muffler	367	3300-6	Replace ether bottle
367	2390-6	Weld pipe to muffler	367	3300-6	Replace ether bottle
367	2421-6	Replace battery	367	3300-6	Replace spring
367	2421-6	Replace battery	367	3300-6	Replace spring
367	2421-6	Service Call	367	3300-6	Rpl Ether Bottle
367	2421-6	Service call	367	3346-6	Adjust clutch
367	2421-6	Service call	367	3346-6	Adjust clutch
367	2441-6	Repair tire	367	3346-6	Replace bearing 2
367	2441-6	Repair tire	367	3346-6	Replace bearing 2
367	2441-6	Rpr Tire	367	3346-6	Replace lock washer
367	2450-6	Repair radiator cap	367	3346-6	Replace lock washer
367	2450-6	Repair radiator cap	367	3346-6	Replace transmisson
367	2450-6	Replace antifreeze	367	3346-6	Replace transmisson
367	2450-6	Replace antifreeze	367	3346-6	Replace transmisson oil
367	2450-6	Replace heater hose	367	3346-6	Replace transmisson oil
367	2450-6	Replace heater hose	367	3346-6	Replace window crank bracket (u
367	2450-6	Replace hose	367	3346-6	Replace window crank bracket (u
367	2450-6	Replace hose	367	3346-6	Rpl Transmission
367	2450-6	Replace radiator cap	367	3404-6	Adjust clutch
367	2450-6	Replace radiator cap	367	3404-6	Adjust clutch
367	2450-6	Replace thermostat	367	3404-6	Misc Auto Rpr
367	2450-6	Replace thermostat	367	3404-6	Replace O-ring
367	2450-6	Service Call	367	3404-6	Replace O-ring

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
367	3404-6	Replace rear seal	375	0320-6	Replace plug wires
367	3404-6	Replace rear seal	375	0320-6	Replace PTO U-joints
367	3404-6	Replace rear seal on trans (use	375	0320-6	Replace PTO U-joints
367	3404-6	Replace rear seal on trans (use	375	0320-6	Replace solenoid relay
367	3404-6	Replace transmission oil	375	0320-6	Replace solenoid relay
367	3404-6	Replace transmission oil	375	0320-6	Replace spark plug
367	3404-6	Replace u-joint	375	0320-6	Replace spark plug
367	3404-6	Replace u-joint	375	0320-6	Reroute fuel line
367	3568-6	Replace compressor	375	0320-6	Reroute fuel line
367	3568-6	Replace compressor	375	0476-6	Check charging system
367	3568-6	Replace oil line fitting (used)	375	0476-6	Check charging system
367	3568-6	Replace oil line fitting (used)	375	0476-6	Replace battery
367	3568-6	Replace oil line (used)	375	0476-6	Replace battery
367	3568-6	Replace oil line (used)	375	0476-6	Rpl Battery
367	3568-6	Rpl Compressor	375	0565-6	Lubricate
367	3575-6	Repair PTO shaft	375	0565-6	Lubricate
367	3575-6	Repair PTO shaft	375	0565-6	Misc Auto Rpr
367	3575-6	Replace u-joint yoke key	375	0565-6	Repair bracket
367	3575-6	Replace u-joint yoke key	375	0565-6	Repair bracket
367	3575-6	Rpr PTO Shaft	375	0565-6	Replace bulbs
375	0004-6	A Maint	375	0565-6	Replace bulbs
375	0004-6	A Maint	375	0565-6	Replace dimmer switch
375	0004-6	A Maint	375	0565-6	Replace dimmer switch
375	0004-6	Install sand spreader	375	0565-6	Replace oil/filter (engine)
375	0004-6	Install sand spreader	375	0565-6	Replace oil/filter (engine)
375	0004-6	Repair 2-speed wiring	375	0565-6	Replace red light assy
375	0004-6	Repair 2-speed wiring	375	0565-6	Replace red light assy
375	0004-6	Replace front wheel bearing	375	0565-6	Replace reflector
375	0004-6	Replace front wheel bearing	375	0565-6	Replace reflector
375	0004-6	Replace front wheel cone	375	0565-6	Replace tail light assy
375	0004-6	Replace front wheel cone	375	0565-6	Replace tail light assy
375	0004-6	Replace quick coupler for sprea	375	0565-6	Replace thermostats
375	0004-6	Replace quick coupler for sprea	375	0565-6	Replace thermostats
375	0004-6	Replace starter	375	0597-6	Install Light
375	0004-6	Replace starter	375	0597-6	Install light
375	0004-6	Replace tail light assy	375	0597-6	Install light
375	0004-6	Replace tail light assy	375	0617-6	Replace distributor
375	0004-6	Replace voltage regulator	375	0617-6	Replace distributor
375	0004-6	Replace voltage regulator	375	0617-6	Rpl Distributor
375	0174-6	Repair exhaust	375	0716-6	Check parts
375	0174-6	Repair exhaust	375	0716-6	Check parts
375	0174-6	Rpr Exhaust	375	0716-6	Chk Parts
375	0298-6	Repair carburetor	375	0809-6	Adjust alternator belt
375	0298-6	Repair carburetor	375	0809-6	Adjust alternator belt
375	0298-6	Repair points	375	0809-6	Check charging system
375	0298-6	Repair points	375	0809-6	Check charging system
375	0298-6	Replace air cleaner	375	0809-6	Chk Charging Sys
375	0298-6	Replace air cleaner	375	0983-6	Adjust carburetor
375	0298-6	Replace condensor	375	0983-6	Adjust carburetor
375	0298-6	Replace condensor	375	0983-6	L Maint
375	0298-6	Replace distributor	375	0983-6	L Maint
375	0298-6	Replace distributor	375	0983-6	L Maint
375	0298-6	Replace ignition points	375	0983-6	Repair PTO shaft
375	0298-6	Replace ignition points	375	0983-6	Repair PTO shaft
375	0298-6	Rpr Carburetor	375	0983-6	Replace compressor filter
375	0320-6	Clean carburetor	375	0983-6	Replace compressor filter
375	0320-6	Clean carburetor	375	0983-6	Replace exhaust clamp
375	0320-6	Misc Auto Rpr	375	0983-6	Replace exhaust clamp
375	0320-6	Rebuild carburetor	375	0983-6	Replace exhaust gasket
375	0320-6	Rebuild carburetor	375	0983-6	Replace exhaust gasket
375	0320-6	Repair tire	375	0983-6	Replace exhaust pipe
375	0320-6	Repair tire	375	0983-6	Replace exhaust pipe
375	0320-6	Replace air filter	375	0983-6	Replace upper radiator hose
375	0320-6	Replace air filter	375	0983-6	Replace upper radiator hose
375	0320-6	Replace distributor	375	1195-6	Repair dump bed/tailgate
375	0320-6	Replace distributor	375	1195-6	Repair dump bed/tailgate
375	0320-6	Replace fuel filter	375	1195-6	Replace seat
375	0320-6	Replace fuel filter	375	1195-6	Replace seat
375	0320-6	Replace in line fuel filter	375	1195-6	Rpr Bed/Tailgate
375	0320-6	Replace in line fuel filter	375	1418-6	Replace heater motor
375	0320-6	Replace plug wires	375	1418-6	Replace heater motor

FEN#	DOC #	DESCRIPTION	FEN#	DOC #	DESCRIPTION
375	1418-6	Rpl Heater Motor	393	0232-6	L Maint
375	1456-6	Adjust timing	393	0232-6	L Maint
375	1456-6	Adjust timing	393	0232-6	L Maint
375	1456-6	Misc Auto Rpr	393	0232-6	Repair muffler clamp
375	1456-6	Replac air filter	393	0232-6	Repair muffler clamp
375	1456-6	Replac air filter	393	0232-6	Repair tire
375	1456-6	Replace fuel filter	393	0232-6	Repair tire
375	1456-6	Replace fuel filter	393	0232-6	Repair wiring
375	1456-6	Replace spark plugs	393	0232-6	Repair wiring
375	1456-6	Replace spark plugs	393	0232-6	Replace plugs
375	1775-6	Adj Emergency Brake	393	0232-6	Replace plugs
375	1775-6	Adjust emergency brake	393	0232-6	Replace manifold bolt
375	1775-6	Adjust emergency brake	393	0232-6	Replace manifold bolt
375	1828-6	Adjust clutch	393	0442-6	Adjust clutch
375	1828-6	Adjust clutch	393	0442-6	Adjust clutch
375	1828-6	Repair tailgate	393	0442-6	Repair carburetor
375	1828-6	Repair tailgate	393	0442-6	Repair carburetor
375	1828-6	Rpr Tailgate	393	0442-6	Repair wiring
375	2121-6	Repair tire	393	0442-6	Repair wiring
375	2121-6	Repair tire	393	0442-6	Replace cylinder key
375	2121-6	Rpr Tire	393	0442-6	Replace cylinder key
375	2143-6	Repair muffler	393	0442-6	Replace ignition switch
375	2143-6	Repair muffler	393	0442-6	Replace ignition switch
375	2143-6	S Maint	393	0442-6	Replace tail/stop lamp
375	2143-6	S Maint	393	0442-6	Replace tail/stop lamp
375	2143-6	S Maint	393	0442-6	Service Call
375	2220-6	Add oil	393	0442-6	Service call
375	2220-6	Add oil	393	0442-6	Service call
375	2220-6	Adjust parking brakes	393	0568-6	Repair defroster hose
375	2220-6	Adjust parking brakes	393	0568-6	Repair defroster hose
375	2220-6	Misc Auto Rpr	393	0568-6	Replace plug
375	2220-6	Repair muffler	393	0568-6	Replace plug
375	2220-6	Repair muffler	393	0568-6	Replace plug wires
375	2220-6	Tighten all transmisson bolts	393	0568-6	Replace plug wires
375	2220-6	Tighten all transmisson bolts	393	0568-6	Replace points
375	2468-6	Install heater shut off	393	0568-6	Replace points
375	2468-6	Install heater shut off	393	0568-6	Rpr Defroster Hose
375	2468-6	Repair PTO Shaft	393	0616-6	Replace distributor cap
375	2468-6	Repair PTO Shaft	393	0616-6	Replace distributor cap
375	2468-6	Repair PTO shaft bracket	393	0616-6	Replace spark plug
375	2468-6	Repair PTO shaft bracket	393	0616-6	Replace spark plug
375	2468-6	Rpr PTO Shaft	393	0616-6	Replace starter
375	2644-6	Repair clutch linkage	393	0616-6	Replace starter
375	2644-6	Repair clutch linkage	393	0616-6	Rpl Starter
375	2644-6	Rpr Clutch Linkage	393	0767-6	Tune Engine
375	2921-6	Adjust carburetor	393	0767-6	Tune engine
375	2921-6	Adjust carburetor	393	0767-6	Tune engine
375	2921-6	Misc Auto Rpr	393	1117-6	Replace tiretibe
375	2921-6	Repair wiring to horn	393	1117-6	Replace tiretibe
375	2921-6	Repair wiring to horn	393	1117-6	Service Call
375	2921-6	Replace bearing	393	1117-6	Service call
375	2921-6	Replace bearing	393	1117-6	Service call
375	2921-6	Replace diaphragm	393	1233-6	Replace u-joint
375	2921-6	Replace diaphragm	393	1233-6	Replace u-joint
375	2921-6	Replace plugs	393	1233-6	Rpl U-Joint
375	2921-6	Replace plugs	393	1261-6	Repair tire
375	2921-6	Sun test	393	1261-6	Repair tire
375	2921-6	Sun test	393	1261-6	Rpr Tire
375	3209-6	L Maint	393	1490-6	Tune Engine
375	3209-6	L Maint	393	1490-6	Tune engine
375	3209-6	L Maint	393	1490-6	Tune engine
375	3243-6	Replace bolt/lock washer	393	1546-6	Repair PTO Linkage
375	3243-6	Replace bolt/lock washer	393	1546-6	Repair PTO linkage
375	3243-6	Steam Clean	393	1546-6	Repalcce u-joint
375	3243-6	Steam clean	393	1546-6	Repalcce u-joint
375	3243-6	Steam clean	393	1546-6	Replace yoke
375	3243-6	Tighten transmisson bolts	393	1546-6	Replace yoke
375	3243-6	Tighten transmisson bolts	393	1546-6	Rpr PTO Linkage
375	3536-6	Tighten Bolts	393	1637-6	Repair emergency brake
375	3536-6	Tighten bolts	393	1637-6	Repair emergency brake
375	3536-6	Tighten bolts	393	1637-6	Repair fuel filter

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
393	1637-6	Repair fuel filter	393	3045-6	Service Call
393	1637-6	Repair muffler bracket	393	3045-6	Service call
393	1637-6	Repair muffler bracket	393	3045-6	Service call
393	1637-6	Replace condenser	393	3054-6	Lubricate
393	1637-6	Replace condenser	393	3054-6	Lubricate
393	1637-6	Replace points	393	3054-6	Replace battery clamp
393	1637-6	Replace points	393	3054-6	Replace battery clamp
393	1637-6	Rpr Emergency Brake	393	3054-6	Replace clutch
393	1637-6	Service call	393	3054-6	Replace clutch
393	1637-6	Service call	393	3054-6	Replace drive cap
393	1732-6	Repair heater motor	393	3054-6	Replace drive cap
393	1732-6	Repair heater motor	393	3054-6	Replace gasket
393	1732-6	Repair lights	393	3054-6	Replace gasket
393	1732-6	Repair lights	393	3054-6	Replace oil
393	1732-6	Repair power steering line	393	3054-6	Replace oil
393	1732-6	Repair power steering line	393	3054-6	Replace oil filter
393	1732-6	Repair wiring	393	3054-6	Replace oil filter
393	1732-6	Repair wiring	393	3054-6	Replace seal
393	1732-6	Repalce transmisson	393	3054-6	Replace seal
393	1732-6	Repalce transmisson	393	3054-6	Replace snap ring
393	1732-6	Replace muffler	393	3054-6	Replace snap ring
393	1732-6	Replace muffler	393	3054-6	Rpl Clutch
393	1732-6	Replace parking brake drum	393	3168-6	Adj Brakes
393	1732-6	Replace parking brake drum	393	3168-6	Adjust brakes
393	1732-6	Replace parking brake lining	393	3168-6	Adjust brakes
393	1732-6	Replace parking brake lining	393	3168-6	Adjust spreader pump
393	1732-6	Replace spark plug	393	3168-6	Adjust spreader pump
393	1732-6	Replace spark plug	393	3277-6	CK Rear Brake
393	1732-6	S Maint	393	3448-6	Adj Brakes
393	1732-6	S Maint	393	3448-6	Adjust brakes
393	1732-6	S Maint	393	3448-6	Adjust brakes
393	1759-6	Repair clutch	393	3448-6	Replace hyd cyl ram bolt
393	1759-6	Repair clutch	393	3448-6	Replace hyd cyl ram bolt
393	1759-6	Repair hoses	393	3549-6	Repair tire
393	1759-6	Repair hoses	393	3549-6	Repair tire
393	1759-6	Replace tail light	393	3549-6	Wash Mower
393	1759-6	Replace tail light	393	3661-6	A Maint
393	1759-6	Service Left Cylinder	393	3661-6	A Maint
393	1759-6	Service left cyliner	393	3661-6	Repair tail light wiring
393	1759-6	Service left cyliner	393	3661-6	Repair tail light wiring
393	1852-6	Repair tire	393	3661-6	Repair tire
393	1852-6	Repair tire	393	3661-6	Repair tire
393	1852-6	Rpn Tire	393	3661-6	Repair tire
393	2054-6	Service Call	393	3661-6	Repair transmisson
393	2161-6	L Maint	393	3661-6	Repair transmisson
393	2161-6	L Maint	393	3661-6	Replace dimmer switch
393	2161-6	L Maint	393	3661-6	Replace dimmer switch
393	2161-6	Repair tie rod	393	3661-6	Replace head light wire
393	2161-6	Repair tie rod	393	3661-6	Replace head light wire
393	2161-6	Repair wiring	393	3661-6	Replace muffler clamp
393	2161-6	Repair wiring	393	3661-6	Replace muffler clamp
393	2765-6	Repair air line	393	3661-6	Weld tail gate
393	2765-6	Repair air line	393	3661-6	Weld tail gate
393	2765-6	Replace key	393	3777-6	Chech rear brake
393	2765-6	Replace key	393	3777-6	Chech rear brake
393	2765-6	Rpl Key	476	0014-6	Repair tire
393	3020-6	Add hydraulic oil	476	0014-6	Replace wheel seal
393	3020-6	Add hydraulic oil	476	0014-6	Rpl Wheel Seal
393	3020-6	Repair hydraulic line	476	0019-6	Replace wheel seal
393	3020-6	Repair hydraulic line	476	0019-6	Rpl Wheel Seal
393	3020-6	Repair PTO shaft	476	0124-6	Repair tire
393	3020-6	Repair PTO shaft	476	0124-6	Replace spark plug
393	3020-6	Repair wiring	476	0124-6	Rpl Spark Plug
393	3020-6	Repair wiring	476	0139-6	Service Call
393	3020-6	Replace bulb	476	0139-6	Service Call
393	3020-6	Replace bulb	476	0225-6	Misc Auto Rpr
393	3020-6	Replace seal	476	0225-6	Rpack bearing
393	3020-6	Replace seal	476	0225-6	Repair tire
393	3020-6	Rpr Hydraulic Line	476	0225-6	Replace bearing seal
393	3045-6	Clean points/dist cap	476	0225-6	Replace eye bolt
393	3045-6	Clean points/dist cap	476	0225-6	Replace wheel motor

FE#	DOC #	DESCRIPTION	FE#	DOC #	DESCRIPTION
476	0225-6	Replace wheel seal	476	2528-6	Adjust valves
476	0317-6	Adjust carburetor	476	2528-6	Clean/lap valves
476	0317-6	Replace strut camper	476	2528-6	Misc Auto Rpr
476	0317-6	Service Call	476	2528-6	Replace engine oil
476	0317-6	Service Call	476	2528-6	Replace fuel cap/gage
476	0379-6	Clean all terminal connectors	476	2528-6	Replace muffler clamp
476	0379-6	Replace battery	476	2528-6	Replace oil filter
476	0379-6	Rpl Battery	476	2625-6	Add engine oil
476	1421-6	Q Maint	476	2625-6	Adjust carburetor
476	1421-6	Q Maint	476	2625-6	Rebuilt fuel pump
476	1421-6	Rebuild engine	476	2625-6	Repair blade shaft
476	1421-6	Replace bushing tail wheel	476	2625-6	Replace carburetor
476	1421-6	Replace caster arm	476	2625-6	Replace cutter blade
476	1421-6	Replace choke control	476	2625-6	Rpl Carburetor
476	1421-6	Replace fuel gage/cap	476	2662-6	Replace deck spring
476	1421-6	Replace hyd oil filter	476	2662-6	Rpl Deck Spring
476	1421-6	Replace spring control rod	476	2698-6	Misc Auto Rpr
476	1421-6	Replace switch clutch	476	2698-6	Repair regulator wire
476	1421-6	Replace wiring harness	476	2698-6	Replace bearing
476	1421-6	Sharpen blades	476	2698-6	Replace blade
476	1466-6	Q Maint	476	2698-6	Replace regulator
476	1466-6	Q Maint	476	2698-6	Replace spindle shaft
476	1876-6	Misc Auto Rpr	476	2698-6	Replace wheel motor
476	1876-6	Replace coil assy	476	2755-6	Misc Auto Rpr
476	1876-6	Replace condensor	476	2755-6	Replace deck spring hangers
476	1876-6	Replace gear box oil	476	2755-6	Replace tail wheel
476	1876-6	Replace point plunger	476	2755-6	Replace tail wheel rim
476	1876-6	Replace point set	476	2764-6	Q Maint
476	1980-6	Replace ignition switch	476	2764-6	Q Maint
476	1980-6	Service Call	476	2764-6	Replace blade
476	1980-6	Service Call	476	2764-6	Replace blade saddle
476	2013-6	Repair wire	476	2764-6	Replace cutter housing bearing
476	2013-6	Rpr Wire	476	2764-6	Replace spindle shaft
476	2062-6	Repair tire	476	2876-6	Repair ground wire
476	2062-6	Rpr Tire	476	2876-6	Service Call
476	2108-6	Repair wires	476	2876-6	Service Call
476	2108-6	Rpr Wires	476	2896-6	Q Maint
476	2131-6	Adjust carburetor	476	2896-6	Q Maint
476	2131-6	Replace cable throttle	476	2896-6	Replace blade
476	2131-6	Rpl Cable Throttle	476	2896-6	Replace blade shaft spindle
476	2145-6	Repair starter switch	476	2935-6	Replace starter motor (used)
476	2145-6	Replace washer	476	2935-6	Service Call
476	2145-6	Rpr Starter Switch	476	2935-6	Service Call
476	2179-6	Replace tail wheel	476	2935-6	Service Call
476	2179-6	Rpl Tail Wheel	476	3036-6	Adjust steering
476	2262-6	Replace carburetor	476	3036-6	Q Maint
476	2262-6	Rpl Carburetor	476	3036-6	Q Maint
476	2262-6	Service battery	476	3036-6	Repair deck blades
476	2273-6	Q Maint	476	3036-6	Replace muffler
476	2273-6	Q Maint	476	3155-6	Rpr Deck Blades
476	2273-6	Replace fuel line	476	3155-6	Replace clamp
476	2273-6	Replace fuel pump	476	3155-6	Replace muffler
476	2273-6	Weld hood	476	3179-6	Rpl Muffler
476	2351-6	Add engine oil	476	3179-6	Adjust steering
476	2351-6	Misc Auto Rpr	476	3179-6	Q Maint
476	2351-6	Rebuild governor mag	476	3179-6	Q Maint
476	2351-6	Replace coil	476	3179-6	Weld deck
476	2351-6	Replace ignition points	476	3179-6	Weld seat
476	2351-6	Replace rod breaker plunger	476	3281-6	Repair steering
476	2351-6	Replace spark plug	476	3281-6	Replace camper thrust
476	2351-6	Weld holes in fender	476	3281-6	Replace turnbuckle
476	2403-6	Repair tire	476	3281-6	Rpl Turnbuckle/Thrust
476	2403-6	Replace balde	476	3343-6	Adjust carburetor
476	2403-6	Replace balde bolt	476	3343-6	Q Maint
476	2403-6	Replace tail wheel assy	476	3343-6	Q Maint
476	2403-6	Rpl Tail Wheel Assy	476	3343-6	Repair deck arm
476	2432-6	Q Maint	476	3343-6	Repair tire
476	2432-6	Q Maint	476	3343-6	Replace lock link
476	2432-6	Replace muffler clamp	476	3343-6	Replace lock pin
476	2494-6	Weld Seat Frame	476	3343-6	Replace spring
476	2494-6	Weld seat frame	476	3388-6	Repair ground wire
			476	3388-6	Rpr Ground Wire

FE#	DOC #	DESCRIPTION
476	3513-6	Rebuild Engine
476	3513-6	Rebuild engine
476	3513-6	Repair tire
476	3786-6	Replace oil switch
476	3786-6	Rpl Oil Switch
476	3791-6	Repair tire
476	3791-6	Rpr Tire
476	3806-6	Replace regulator
476	3806-6	Rpl Regulator/Weld Deck
476	3806-6	Troubleshoot
476	3806-6	Weld deck
476	3825-6	Repair regulator wires
476	3825-6	Replace blade
476	3825-6	Replace spark plug
476	3825-6	Replace tail wheel caster fork
476	3825-6	Service Call
476	3825-6	Service Call
476	3955-6	Adjust carburetor
476	3955-6	Adjust steering
476	3955-6	Q Maint
476	3955-6	Q Maint
476	3955-6	Replace belts
476	3955-6	Replace regulator
476	3955-6	Replace turnbuckle
476	3955-6	Replace washer
476	3955-6	Weld deck

**APPENDIX E: SUMMARY DATA TABLES**

**Table E1**  
**Breakdown of Service Visits**

<b>Data Files</b>	<b>Service Visits</b>			<b>Repair Tasks</b>		
	<b>Total Visits</b>	<b>Unit Only</b>	<b>Support Only</b>	<b>Both Unit &amp; Support</b>	<b>Unit Tasks</b>	<b>Support Tasks</b>
1	906	686	46	174	2,436	387
2	1,047	753	51	243	3,099	636
3	767	560	26	181	3,078	517
4	859	613	30	216	3,201	615
5	<u>361</u>	<u>250</u>	<u>12</u>	<u>99</u>	<u>1,393</u>	<u>247</u>
	<b>3,940</b>	<b>2,862</b>	<b>165</b>	<b>913</b>	<b>13,207</b>	<b>2,402</b>

**Table E2**  
**Vehicle Maintenance Labor Hours and Costs for Fort Riley, KS (1986)**

FILE NAME	UNIT LABOR HOURS	SUPPORT LABOR HOURS	TOTAL LABOR HOURS	UNIT LABOR DOLLARS		SUPPORT LABOR DOLLARS		TOTAL ADJ LABOR DOLLARS
				UNADJ	ADJUSTED	UNADJ	ADJUSTED	
#2_ORG_M	1,583.93	514.60	2,098.53	\$26,490	\$26,547	\$8,625	\$8,625	\$35,171
#3_ORG_M	547.50	260.40	807.90	\$9,192	\$9,176	\$4,365	\$4,364	\$13,540
BECKY_OR	1,410.00	585.20	1,995.20	\$99	\$23,632	\$0	\$9,808	\$33,440
C_ORG_MA	951.60	509.80	1,461.40	\$9	\$15,949	\$0	\$8,544	\$24,493
D_ORG_MA	984.80	457.50	1,442.30	\$437	\$16,505	\$14	\$7,668	\$24,173
E_ORG_MA	525.50	258.85	784.35	\$5	\$8,807	\$6	\$4,338	\$13,146
F_ORG_MA	402.90	252.70	655.60	\$44	\$6,753	\$7	\$4,235	\$10,988
G_ORG_MA	494.89	176.50	671.39	\$150	\$8,294	\$0	\$2,958	\$11,252
H_ORG_MA	514.00	271.49	785.49	\$0	\$8,615	\$0	\$4,550	\$13,165
I_ORG_MA	582.95	79.50	662.45	\$0	\$9,770	\$0	\$1,332	\$11,103
J_ORG_MA	478.10	228.90	707.00	\$0	\$8,013	\$0	\$3,836	\$11,849
K_ORG_MA	510.00	433.60	943.60	\$0	\$8,548	\$0	\$7,267	\$15,815
L_ORG_MA	545.10	282.00	827.10	\$3	\$9,136	\$76	\$4,726	\$13,862
MAIN1	4,050.60	597.30	4,647.90	\$73,057	\$67,888	\$10,011	\$10,011	\$77,899
MAIN2	1,389.40	605.80	1,995.20	\$99	\$23,286	\$0	\$10,153	\$33,440
MAIN3	1,023.00	478.60	1,501.60	\$60	\$17,145	\$620	\$8,021	\$25,167
M_ORG_MA	532.57	141.70	674.27	\$28	\$8,926	\$0	\$2,375	\$11,301
G_ORG_OR	501.90	159.00	660.90	\$8,412	\$8,412	\$2,638	\$2,665	\$11,077
H_ORG_OR	574.90	189.40	764.30	\$9,635	\$9,635	\$2,856	\$3,174	\$12,810
I_ORG_OR	624.75	26.00	650.75	\$10,533	\$10,471	\$436	\$436	\$10,907
J_DM_OR	566.00	145.50	711.50	\$9,486	\$9,486	\$2,439	\$2,439	\$11,925
K_DM_OR	664.80	277.80	942.60	\$11,159	\$11,142	\$4,656	\$4,656	\$15,798
L_DM_OR	645.60	181.50	827.10	\$10,820	\$10,820	\$3,042	\$3,042	\$13,862
L_ORG_MA	2.00	0.00	2.00	\$0	\$34	\$0	\$0	\$34
M_DM_OR	516.77	157.50	674.27	\$8,661	\$8,661	\$2,640	\$2,640	\$11,301
M_ORG_MA	517.57	157.20	674.77	\$0	\$8,674	\$0	\$2,635	\$11,309
N_DM_OR	612.80	41.00	653.80	\$10,271	\$10,271	\$687	\$687	\$10,958
N_ORG_MA	477.80	167.00	644.80	\$0	\$8,008	\$0	\$2,799	\$10,807
O_ORG_MA	615.70	148.50	764.20	\$0	\$10,319	\$0	\$2,489	\$12,808
O_DM_OR	682.70	79.50	762.20	\$11,442	\$11,442	\$1,332	\$1,332	\$12,774
P_ORG_M	448.70	243.00	691.70	\$0	\$7,520	\$0	\$4,073	\$11,593
P_DM_OR	556.90	130.30	687.20	\$9,334	\$9,334	\$2,184	\$2,184	\$11,517
Q_DM_ORG	268.50	1.30	269.80	\$4,433	\$4,500	\$22	\$22	\$4,522
Q_ORG_MA	240.00	25.80	265.80	\$0	\$4,022	\$0	\$432	\$4,455
	25,044.23	8,264.74	33,308.97	\$213,857	\$419,741	\$46,654	\$138,517	\$558,258
					50.95%	33.68%		
						75.19%		24.81%
								100.00%

UNADJUSTED AS A PERCENT OF ADJUSTED  
ACTUAL AS A PERCENT OF TOTAL

**Table E3**  
**Vehicle Maintenance Parts and Labor Dollars and**  
**Labor Hours for Fort Riley, KS (1986)**

FILE NAME	PARTS DOLLARS			LABOR HOURS			LABOR DOLLARS		
	UNIT	SUPPORT	TOTAL	UNIT	SUPPORT	TOTAL	UNIT	SUPPORT	TOTAL
#2_ORG_M	\$34,870	\$16,561	\$51,432	1,584	515	2,099	\$26,547	\$8,625	\$35,171
#3_ORG_M	\$8,576	\$3,477	\$12,054	548	260	808	\$9,176	\$4,364	\$13,540
BECKY_OR	\$43,260	\$27,081	\$70,340	1,410	585	1,995	\$23,632	\$9,808	\$33,440
C_ORG_MA	\$15,749	\$9,439	\$25,187	952	510	1,461	\$15,949	\$8,544	\$24,493
D_ORG_MA	\$19,023	\$21,896	\$40,919	985	458	1,442	\$16,505	\$7,668	\$24,173
E_ORG_MA	\$5,792	\$6,621	\$12,412	526	259	784	\$8,807	\$4,338	\$13,146
F_ORG_MA	\$4,137	\$5,394	\$9,531	403	253	656	\$6,753	\$4,235	\$10,988
G_ORG_MA	\$6,676	\$3,318	\$9,993	495	177	671	\$8,294	\$2,958	\$11,252
H_ORG_MA	\$4,873	\$2,898	\$7,772	514	271	785	\$8,615	\$4,550	\$13,165
I_ORG_MA	\$6,437	\$1,973	\$8,410	583	80	662	\$9,770	\$1,332	\$11,103
J_ORG_MA	\$5,957	\$7,497	\$13,454	478	229	707	\$8,013	\$3,836	\$11,849
K_ORG_MA	\$8,783	\$13,438	\$22,221	510	434	944	\$8,548	\$7,267	\$15,815
L_ORG_MA	\$6,649	\$7,016	\$13,665	545	282	827	\$9,136	\$4,726	\$13,862
MAIN1	\$106,501	\$27,894	\$134,395	4,051	597	4,648	\$67,888	\$10,011	\$77,899
MAIN2	\$42,344	\$27,997	\$70,340	1,389	606	1,995	\$23,286	\$10,153	\$33,640
MAIN3	\$16,356	\$21,822	\$38,178	1,023	479	1,502	\$17,145	\$8,021	\$25,167
M_ORG_MA	\$7,220	\$4,447	\$11,668	533	142	674	\$8,926	\$2,375	\$11,301
G_-_ORG	\$6,311	\$3,767	\$10,078	502	159	661	\$8,412	\$2,665	\$11,077
H_-_ORG	\$5,121	\$2,902	\$8,023	575	189	764	\$9,635	\$3,174	\$12,810
I_-_ORG	\$7,847	\$505	\$8,352	625	26	651	\$10,471	\$436	\$10,907
J_-_OM_OR	\$7,743	\$1,942	\$9,685	566	146	712	\$9,486	\$2,439	\$11,925
K_-_OM_OR	\$8,869	\$3,482	\$12,352	665	278	943	\$11,142	\$4,656	\$15,798
L_-_OM_OR	\$8,086	\$5,639	\$13,725	646	182	827	\$10,820	\$3,042	\$13,862
L_ORG_MA	\$0	\$0	\$0	2	0	2	\$34	\$0	\$34
M_-_OM_OR	\$5,587	\$1,505	\$7,092	517	158	674	\$8,661	\$2,640	\$11,301
M_ORG_MA	\$7,481	\$4,214	\$11,695	518	157	675	\$8,674	\$2,635	\$11,309
N_-_OM_OR	\$6,702	\$258	\$6,960	613	41	654	\$10,271	\$687	\$10,958
N_ORG_MA	\$4,944	\$4,159	\$9,103	478	167	645	\$8,008	\$2,799	\$10,807
O_ORG_MA	\$6,292	\$2,114	\$8,406	616	149	764	\$10,319	\$2,489	\$12,808
O_-_OM_OR	\$7,932	\$644	\$8,576	683	80	762	\$11,442	\$1,332	\$12,774
P_-_ORG_M	\$4,955	\$12,570	\$17,525	449	243	692	\$7,520	\$4,073	\$11,593
P_-_OM	\$10,689	\$2,929	\$13,618	557	130	687	\$9,334	\$2,184	\$11,517
Q_-_OM_ORG	\$4,094	\$0	\$4,094	269	1	270	\$4,500	\$22	\$4,522
Q_ORG_MA	\$3,607	\$488	\$4,094	240	26	266	\$4,022	\$432	\$4,455
	\$449,465	\$255,887	\$705,352	25,044	8,265	33,309	\$419,741	\$138,517	\$558,258
	64%	36%	100%	75%	25%	100%	75%	25%	100%

PERCENT OF TOTAL

**Table E4**  
**Vehicle Maintenance Unit and Support Costs for Fort Riley, KS (1986)**

FILE NAME	UNIT			SUPPORT			TOTAL	
	PARTS \$	LABOR \$	TOTAL \$	PARTS \$	LABOR \$	TOTAL \$	UNIT & SUPPORT \$	
#2_ORG_M	\$34,870	\$26,547	\$61,417	\$16,561	\$8,625	\$25,186	\$86,603	
#3_ORG_M	\$8,576	\$9,176	\$17,753	\$3,477	\$4,364	\$7,842	\$25,594	
BECKY-OR	\$43,260	\$23,632	\$66,891	\$27,081	\$9,808	\$36,889	\$103,780	
C_ORG_MA	\$15,749	\$15,949	\$31,698	\$9,439	\$8,544	\$17,983	\$49,680	
D_ORG_MA	\$19,023	\$16,505	\$35,528	\$21,896	\$7,668	\$29,564	\$65,092	
E_ORG_MA	\$5,792	\$8,807	\$14,599	\$6,621	\$4,338	\$10,959	\$25,558	
F_ORG_MA	\$4,137	\$6,753	\$10,890	\$5,394	\$4,235	\$9,629	\$20,519	
G_ORG_MA	\$6,676	\$8,294	\$14,970	\$3,318	\$2,958	\$6,276	\$21,246	
H_ORG_MA	\$4,873	\$8,615	\$13,488	\$2,898	\$4,550	\$7,448	\$20,936	
I_ORG_MA	\$6,437	\$9,770	\$16,207	\$1,973	\$1,332	\$3,306	\$19,512	
J_ORG_MA	\$5,957	\$8,013	\$13,970	\$7,497	\$3,836	\$11,334	\$25,303	
K_ORG_MA	\$8,783	\$8,548	\$17,331	\$13,438	\$7,267	\$20,705	\$38,036	
L_ORG_MA	\$6,649	\$9,136	\$15,785	\$7,016	\$4,726	\$11,743	\$27,528	
MAIN1	\$106,501	\$67,888	\$174,390	\$27,894	\$10,011	\$37,905	\$212,294	
MAIN2	\$42,344	\$23,286	\$65,630	\$27,997	\$10,153	\$38,150	\$103,780	
MAIN3	\$16,356	\$17,145	\$33,502	\$21,822	\$8,021	\$29,843	\$63,345	
M_ORG_MA	\$7,220	\$8,926	\$16,146	\$4,447	\$2,375	\$6,822	\$22,968	
G_-_ORG	\$6,311	\$8,412	\$14,722	\$3,767	\$2,665	\$6,432	\$21,155	
H_-_ORG	\$5,121	\$9,635	\$14,757	\$2,902	\$3,174	\$6,076	\$20,833	
I_-_ORG	\$7,847	\$10,471	\$18,318	\$505	\$436	\$941	\$19,259	
J_-_OM_OR	\$7,743	\$9,486	\$17,229	\$1,942	\$2,439	\$4,381	\$21,610	
K_-_OM_OR	\$8,869	\$11,142	\$20,011	\$3,482	\$4,656	\$8,138	\$28,150	
L_-_OM_OR	\$8,086	\$10,820	\$18,906	\$5,639	\$3,042	\$8,681	\$27,587	
L_ORG_MA	\$0	\$34	\$34	\$0	\$0	\$0	\$0	\$34
M_-_OM_OR	\$5,587	\$8,661	\$14,248	\$1,505	\$2,640	\$4,145	\$18,393	
M_ORG_MA	\$7,481	\$8,674	\$16,156	\$4,214	\$2,635	\$6,848	\$23,004	
N_-_OM_OR	\$6,702	\$10,271	\$16,973	\$258	\$687	\$945	\$17,918	
N_ORG_MA	\$4,944	\$8,008	\$12,952	\$4,159	\$2,799	\$6,958	\$19,910	
O-ORG_MA	\$6,292	\$10,319	\$16,612	\$2,114	\$2,489	\$4,603	\$21,214	
O_-_OM_OR	\$7,932	\$11,442	\$19,374	\$644	\$1,332	\$1,976	\$21,350	
P_-_ORG_M	\$4,955	\$7,520	\$12,476	\$12,570	\$4,073	\$16,643	\$29,118	
P_-_OM_	\$10,689	\$9,334	\$20,023	\$2,929	\$2,184	\$5,113	\$25,135	
Q_OM_ORG	\$4,094	\$4,500	\$8,594	\$0	\$22	\$22	\$8,616	
Q_ORG_MA	\$3,607	\$4,022	\$7,629	\$488	\$432	\$920	\$8,549	
	<b>\$449,465</b>	<b>\$419,741</b>	<b>\$869,207</b>	<b>\$255,887</b>	<b>\$138,517</b>	<b>\$394,404</b>	<b>\$1,263,610</b>	

68.79%

31.21%

ACTUAL AS A PERCENT OF TOTAL

**Table E5**  
**Reconstruction of TAMMS Process Costs**

<b>Step*</b>	<b>Item</b>	<b>Value</b>	<b>Source</b>
4.	Unit repair cases	2,862	
	Inspection hours per repair**	<u>x 1.5</u>	[Table E1]
	Total unit inspection hours	4293	
	Labor rate***	<u>x \$16.76</u>	
		\$71,951	
5.	Unit repair and inspection hours	419,741	[Table E4]
	Total unit repair hours less inspection time percentage based on 6 day survey (100 - 4.75)	<u>95.25%</u> 399,803	[Table E7]
6.	Value in "4" above	71,951	
	Value in "5" above	<u>399,803</u>	
	Total unit repairs	471,754	
7.	Support only plus both support and unit repair cases	1,078	[Table E1]
	Inspection hours per repair	2	
	Total support inspection hours	2,156	
	Labor rate	<u>x \$16.76</u>	
		\$36,136	
8.	Support repair and inspection hours	138,517	[Table E4]
	Total support repair hours less inspection time percentage based on six day survey (100 - 0.91)	<u>9.09%</u> 137,256	[Table E7]
9.	Value in "7" above	36,135	
	Value in "8" above	<u>137,256</u>	
	Total support repairs	173,391	

\*Step number corresponds to the steps outlined in Chapter 2.  
 \*\*"Inspection hour" as previously defined.  
 \*\*\*"Labor rate" as previously defined.

**Table E6**  
**Comparison of Service Writer and TAMMS Process Costs**

<b>Service Writer Process</b>	<b>Labor Only</b>	<b>Parts</b>	<b>Parts &amp; Labor</b>
Total annual cost of mechanic repair and inspection time unit level cases (from Table 5)	419,741	449,465	869,207
Support level cases (from Table 5)	138,517	255,887	394,404
Total all cases	558,258	705,352	1,263,610
<b>TAMMS Process</b>			
Total annual cost of unit level costs (from Table 7)			
Inspection	71,951		
Repairs	399,803		
Total unit level	471,754		
Total annual cost of support level costs (from Table 7)			
Inspection	36,135		
Repairs	137,256		
Total support level	173,391		
Total unit and support costs	645,145	705,352	1,350,497
<b>TAMMS Process less Service Writer Process</b>	<b>86,887</b>		<b>86,887</b>
<b>Percent Savings</b>	<b>13.5%</b>		<b>6.4%</b>

**Table E7**  
**Analysis of Time-In-Motion Observations By Repair Type**  
**And Type Of Maintenance Action**

Description of Value	Comments	Pro- ductive	Non- productive	Indirect Productive	Total Time	Inspection* Time
Total Time, by Component (%)	Unit + Support	55.56	32.26	11.94	100.00	3.51
Total Support (Hours)	Support	17.13	9.25	3.20	29.77	0.27
Support Time, by Component (%)	Support	57.55	31.08	10.74	100.00	0.91
Total Unit (Hours)	Unit	34.18	20.54	7.82	62.58	2.97
Unit Time, by Component (%)	Unit	54.62	32.82	12.50	100.00	4.75
Unit as a Percent of Total Time (%)		66.61	68.94	70.98	67.76	91.66

\*Inspection time is included with productive time.

**Table E8**  
**Summary of Time-And-Motion Study**

	Productive		Nonproductive	Indirect Productive	Total Time
	Inspection	Other			
All Repairs*	4**	52	32	12	100
Unit	1	50	33	12	100
Support	1	57	31	11	100

\*All repairs are a weighted average of unit and support level maintenance cases.  
\*\*Values are percentages.

**APPENDIX F: JOB FREQUENCY BY VEHICLE NUMBER AND  
NUMBER OF JOBS PERFORMED**

Job Frequency		Job Frequency		Job Frequency	
Sorted by Vehicle #		Sorted by Number of Jobs Performed		Sorted by Vehicle #	
FE#	# of Jobs	FE#	# of Jobs	FE#	# of Jobs
1	157	59	2	76	4
2	188	71	2	80	6
3	89	76	2	81	8
4	63	103	2	82	14
6	121	118	2	83	8
8	5	141	2	85	26
9	270	153	2	86	8
10	191	163	2	87	7
11	81	204	2	88	6
12	12	239	2	89	13
13	129	490	2	92	3
14	108	503	2	93	16
15	261	73	3	101	79
16	41	92	3	102	55
17	59	117	3	103	2
18	247	137	3	104	52
19	152	139	3	106	63
20	39	240	3	107	91
23	57	311	3	108	50
24	182	344	3	109	14
25	146	345	3	110	6
27	66	346	3	111	6
28	53	347	3	112	11
29	36	348	3	113	28
30	8	66	4	114	13
31	35	67	4	115	9
32	68	76	4	116	7
33	64	130	4	117	3
34	68	135	4	118	2
35	54	136	4	119	5
36	10	140	4	120	101
37	47	143	4	121	73
38	10	223	4	122	80
39	104	227	4	123	80
40	45	232	4	124	13
41	38	502	4	125	7
42	43	8	5	126	54
43	61	119	5	127	62
44	85	157	5	130	4
46	56	160	5	131	20
47	48	222	5	132	11
48	39	235	5	133	13
49	57	69	6	134	8
50	33	75	6	135	4
51	23	80	6	136	6
52	44	88	6	137	3
53	8	110	6	138	26
54	57	111	6	139	3
55	84	176	6	140	4
56	54	205	6	141	2
57	32	231	6	143	4
59	2	441	6	145	36
60	47	475	6	146	43
61	105	491	6	147	15
62	58	72	7	150	115
63	26	87	7	152	8
64	16	116	7	153	2
66	4	125	7	154	17
67	4	159	7	155	16
68	9	165	7	157	5
69	6	220	7	158	9
71	2	388	7	159	7
72	7	453	7	160	5
73	3	472	7	161	18
74	2	488	7	162	26
75	6	30	8	163	2

## Job Frequency

## Job Frequency

Sorted by Vehicle #		Sorted by Number of Jobs Performed		Sorted by Vehicle #		Sorted by Number of Jobs Performed	
FE#	# of Jobs	FE#	# of Jobs	FE#	# of Jobs	FE#	# of Jobs
165	7	109	14	267	23	281	23
166	9	292	14	268	63	501	23
170	18	329	14	273	11	138	24
171	9	385	14	274	24	274	24
176	6	438	14	275	19	276	24
177	9	147	15	276	24	309	24
178	60	290	15	277	12	410	24
179	111	300	15	278	27	433	24
180	58	307	15	279	26	259	25
181	69	419	15	280	18	465	25
182	109	429	15	281	23	63	26
183	137	460	15	282	11	85	26
184	158	461	15	283	9	162	26
185	114	462	15	284	36	279	26
186	132	64	16	286	13	317	26
187	117	93	16	287	11	324	26
188	50	155	16	288	11	334	26
189	56	294	16	289	10	373	26
190	8	430	16	290	15	447	26
191	92	431	16	291	8	482	26
192	43	454	16	292	14	196	27
193	35	154	17	293	17	278	27
194	95	247	17	294	16	310	27
195	34	257	17	296	83	384	27
196	27	293	17	300	15	400	27
198	68	381	17	301	63	416	27
202	30	161	18	302	31	418	27
204	2	170	18	303	46	432	27
205	6	280	18	305	153	457	27
213	8	312	18	306	29	113	28
219	11	316	18	307	15	327	28
220	7	321	18	308	21	423	28
221	13	386	18	308	10	446	28
222	5	248	19	309	24	306	29
223	4	275	19	310	27	319	29
224	12	357	19	311	3	202	30
225	10	370	19	312	18	258	30
226	21	380	19	313	45	264	30
227	4	387	19	314	47	265	30
230	11	440	19	315	34	445	30
231	6	452	19	316	18	448	30
232	4	131	20	317	26	302	31
235	5	414	20	318	39	320	31
239	2	421	20	319	29	358	31
240	3	451	20	320	31	369	31
245	62	466	20	321	18	407	31
246	21	483	20	322	38	57	32
247	17	226	21	323	21	249	32
248	19	246	21	324	26	260	32
249	32	252	21	325	38	471	32
250	36	308	21	326	34	50	33
251	23	323	21	327	28	262	33
252	21	330	21	328	40	356	33
253	11	342	21	329	14	195	34
254	36	382	21	330	21	256	34
255	23	415	21	331	58	315	34
256	34	464	21	332	8	326	34
257	17	467	21	333	43	493	34
258	30	469	21	334	26	497	34
259	25	383	22	336	9	31	35
260	32	455	22	337	13	193	35
262	33	468	22	339	53	428	35
263	63	51	23	340	50	29	36
264	30	251	23	341	94	145	36
265	30	255	23	342	21	250	36
266	63	267	23	343	12	254	36

Job Frequency		Job Frequency	
Sorted by Vehicle #		Sorted by Number of Jobs Performed	
FE#	# of Jobs	FE#	# of Jobs
344	3	284	36
345	3	403	36
346	3	495	36
347	3	496	36
348	3	469	37
349	166	61	38
350	112	322	38
351	129	325	38
352	53	20	39
353	92	48	39
354	112	318	39
356	33	498	39
357	19	328	40
358	31	379	40
359	140	408	40
360	131	16	41
361	72	422	41
364	66	456	41
365	243	42	43
366	109	146	43
367	286	192	43
368	44	333	43
369	31	52	44
370	19	368	44
371	44	371	44
372	46	463	44
373	26	492	44
374	47	494	44
375	193	40	45
376	55	313	45
377	8	420	45
378	12	303	46
379	40	364	46
380	19	372	46
381	17	37	47
382	21	60	47
383	22	314	47
384	27	374	47
385	14	47	48
386	18	198	48
387	19	396	48
388	7	413	48
389	84	435	48
390	90	108	50
391	178	188	50
392	116	340	50
393	197	399	51
394	65	458	51
395	83	104	52
396	48	28	53
397	123	339	53
398	83	352	53
399	51	499	53
400	27	35	54
401	12	56	54
403	36	126	54
405	74	434	54
406	128	102	55
407	31	376	55
408	40	500	55
410	24	46	56
411	61	189	56
413	48	23	57
414	20	69	57
415	21	54	57
416	27	478	57

Job Frequency

Sorted by Vehicle #

FEM#	# of Jobs
485	8
487	8
488	7
489	10
490	2
491	6
492	44
493	36
494	44
495	36
496	36
497	34
498	39
499	53
500	55
501	23
502	4
503	2

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Sorted by Number  
of Jobs Performed

FEM#	# of Jobs
305	153
477	153
1	157
184	158
349	166
391	178
24	182
479	183
476	184
2	188
10	191
375	193
393	197
365	243
18	247
15	261
9	270
367	286

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